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ABSTRACT

These proceedings of a conference sponsored by the International Biological Programme committee of the Australian Academy of Science contain the six major papers presented to the conference. An overview of the perspectives and responsibilities resulting from environmental change is followed by an outline of a strategy for curriculum development and implementation in environmental education at elementary and secondary levels. Three other papers are concerned with biological education; one an analysis of curricula and textbooks used in Australian schools from the point of view of relevance to environmental issues; one an account of a biologically based environmental education course for non-biologists at university level; and one the discussion of teaching biology to infants. A paper on the responsibilities of the mass media for producing an groups on "Environmental Education in the Schools," "Environmental Education in the Community," "Environmental Education at the Tertiary Level" and "The Education of Environmental Scientists" conclude the report. A list of conference participants is appended. (AL)

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AUSTRALIAN ACADEMY OF SCIENCE

EDUCATION AND THE ENVIRONMENTAL CRISIS

REPORTS OF THE AUSTRALIAN ACADEMY OF SCIENCE NUMBER 13

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AUSTRALIAN ACADEMY OF SCIENCE

EDUCATION AND THE ENVIRONMENTAL CRISIS

Proceedings of a Conference held in Canberra, 24-26th April 1970 under the auspices of the Australian Academy of Science through its National Committee for the International Biological Programme.

Edited by Jeremy Evans and Stephen Boyden

REPORTS OF THE AUSTRALIAN ACADEMY OF SCIENCE NUMBER 13

CANBERRA DECEMBER 1970

"We can and we must spell out public policies for the control of all those forms of pollution with which we are debasing our environment and for the creation of harmonious cities, but we shall not achieve very impressive results unless education at the very earliest stage breathes into our conscience reverence for the earth's bounty, on which we depend, and regard for beauty as Man's only lasting achievement."

Bertrand de Jouvenel

"The Stewardship of the Earth", 1968, In *The Fitness of Man's Environment* Smithsonian Institution Press, Washington, D.C.

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INTRODUCTION

Recognising the key role of education in preparing society to cope with the problems of environmental quality, the Australian Academy of Science's National Committee for the IBP selected "Education and the Environmental Crisis" as the theme for the second national IBP Conference.

The purposes of the Conference were:

1. To enquire into the extent to which educational authorities, especially in Australia, have responded to the present environmental situation by introducing educational programmes designed to create an awareness of the nature of this situation and to stimulate thinking about the ways and means by which society might overcome the threats inherent in it, and
2. To bring about an exchange of views on the responsibilities of educational institutions and of the mass media in relation to the environmental situation, and an exchange of views on positive steps that might be taken to ensure that these responsibilities are adequately discharged.

This volume contains the papers presented at the Conference, the comments of the discussion openers and the reports of the four working groups. These groups met on the morning of the third and last day of the Conference and their chairmen drafted reports of their conclusions during the lunch period that followed. The reports were presented to a final plenary session during the afternoon and, after some discussion, were adopted by vote. Unfortunately, the time available for the meetings of the working groups was too brief and, as a result, the reports are less thorough than they might have been. Nevertheless, we feel that they contain many valuable observations and recommendations.

The organising committee of the Conference* wishes to express its appreciation to all those whose enthusiasm and hard work helped to make the Conference a stimulating and rewarding experience.

Jeremy Evans
Stephen Boyden

* Dr Stephen Boyden, Dr Jeremy Evans, Dr Bryan Furnass, Mrs Margaret Robinson and Professor Donald Walker.
Secretarial assistance: Mrs Jean Wilson, A.N.U.
Editorial assistance: Miss Elizabeth Newman, Australian Academy of Science.

CHAIRMAN'S REMARKS. By Otto Frankel*

When the small group which organized this Conference discussed its title, some felt that the one which was chosen sounded somewhat alarmist and immodest. Yet in the few months since then it has become even clearer that in many areas, and in many different ways, a truly critical state has been reached and alarm is becoming world-wide. The dynamics of deterioration of the environment have equalled or exceeded the dynamics of human populations.

At its inception in the early sixties, The International Biological Programme (IBP) was conceived as a coordinated study of the bases of productivity and of man's adaptability in a rapidly changing world. At that time the environmental crisis was seen primarily as a food crisis, and increased productivity as the greatest short and long-term problem. Now, only some eight years later, food needs are recognized as only one among a number of pressing problems and, unlike the food crisis, which threatens the less developed regions, the deterioration of the environment threatens to engulf the whole world, but, particularly and immediately, the most highly developed regions.

Almost imperceptibly, productivity studies have been broadened in purpose and design, growing into multi-disciplinary studies of major ecosystems, of biomes, studies which are to result in models which are subject to experimental test and capable of predictive analysis. We have advanced from the study of particular features to the study of Man and the Biosphere.

The IBP is an activity conceived and led by scientists, represented by their national academies and united in ICSU (the International Council of Scientific Unions), which initiated the IBP and under whose auspices it proceeds. Now with its termination only a few years away and under the impact of the environmental crisis, a world programme with a firmer organizational and financial base has been found necessary and urgent. UNESCO, in association with other UN agencies, the UN itself, and with ICSU and IUCN (the International Union for the Conservation of Nature), is planning an international and inter-governmental programme under the title "Man and the Biosphere". Its general purposes are (1) to study the functioning and structure of the biosphere and its ecological regions; (2) to conduct systematic observations and research on changes brought about by man on the biosphere and its resources; (3) to observe the overall effects of these changes upon

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the human species; and (4) to stimulate education and information upon these matters.

Adding to the understanding of the environment, to the extent that actions and interactions become predictable in their consequences, will help us to manage the environment with greater efficiency and, one may hope, wisdom. No doubt some of our present-day problems, such as the pollution of air and water or the avoidable waste and destruction of resources, can be mitigated, even solved, by science and technology but, as Dr Boyden reasons in the first paper of this Conference, the problems which have been and are continuing to be created by the expansion of science and technology, themselves, cannot be solved by them alone. Ultimately, one feels, they must lead to self-destruction in some of the ways which can now be dimly discerned.

What is needed is not only a fuller understanding of the biosphere, but a new sense of values, a new perception of our own role and responsibilities in and for the biosphere. These responsibilities are beginning to be understood and appreciated and we may yet learn to accept them before our air, land and water are hopelessly polluted, our landscape is despoiled by short-sighted development, our towns are made hideous by avoidable roads, and our plants and animals are decimated and alienated. Alas, this transformation of basic attitudes cannot come as rapidly nor as drastically as the environmental crisis demands. Our only hope is that this new understanding may develop through the education of old and young and it is the privilege of this Conference to give emphasis and lead to what is now perhaps the most pressing and most important aspect of education for the coming decades.

ENVIRONMENTAL CHANGE : PERSPECTIVES AND RESPONSIBILITIES. By Stephen Boyden.

Most of us would agree, I imagine, that one of the prime aims of education should be to provide the individual with a balanced and coherent picture of the human situation in historical and biological perspective, and with an awareness and understanding of the nature of the most important problems that face his society. It should also aim to stimulate his thinking so that he is able to play his full part in the collective efforts of his community to cope with these problems.

Assuming, then, that one of the primary objectives of education at any time should be to transmit information about, and to stimulate interest in the major problems of the day, it is appropriate to begin this introductory paper with some discussion on what these problems are in the case of our contemporary society. I shall return towards the end of this paper to the special role and responsibilities of educators in these matters.

However, before considering the current situation, let us go back in time and consider briefly some of the events of outstanding significance which prepared the ground for the important global developments which are our main concern today. It was between two and three thousand million years ago that a new set of processes – the processes of life – began to appear and superimpose themselves, so to speak, on the inorganic world. While these new processes were, of course, utterly dependent on the more ancient physicochemical processes on which they were based, they eventually gave rise to a highly complex and diverse system of living organisms, which has transformed the character of the earth's surface to a considerable extent. And then, only some two million years ago, the first glimmers appeared of yet another new set of processes – the processes of human culture – a development which was destined to prove perhaps as significant as the origin of life itself. Just as the processes of life are both dependent upon and yet different from the physical and chemical processes which preceded them, so it is with the processes of human culture. They arose from, depend upon, and yet are in many ways different from the processes of life. Incidentally, it is noteworthy that biologists seem to have discovered rather earlier than students of culture that they cannot adequately study the phenomena of life without paying due attention to the underlying processes from which they arose and on which they depend. Indeed, in

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this country a person may be considered properly qualified to study human society either as an anthropologist or as a sociologist even if he has never done a single day's biology in his life, even at school.

It was not until the neolithic development, some ten or twelve thousand years ago, when some of our ancestors began actually to manipulate the processes of nature for their own ends, that the potentialities of human culture as a new force in the biosphere were first manifest. The impact was, of course, relatively slight at first and restricted to certain localised areas on the earth's surface; but there began with the neolithic development an interaction between the ancient processes of nature and the new forces of culture, an interaction which, as culture has evolved, has increased enormously in intensity. It is this continually increasing intensity of the interaction between these two sets of processes that is responsible for the so-called "environmental crisis" which is causing such serious concern among many ecologists and which is seen by many to represent a very grave threat to human well-being and survival.

There is, of course, no simple way of assessing or expressing the increasing impact of our civilisation on the biosphere and its natural resources. Some indication can be gained from the fact that the number of specimens of *Homo sapiens* alive on earth today is some eight hundred times greater than at any time before the neolithic development. However, because of advances in technology and the rapidly growing use of energy by man through his exploitation of fossil fuels, the total impact of human society on the biosphere has increased by a factor much greater than eight hundred.

All life on earth is, of course, supported by the energy trapped from sunlight by the green plants through the process of photosynthesis. It is, I think, revealing to compare the estimates of the total amount of energy thus captured by photosynthesis with the figures for the energy consumption by human society at the present time. Precise figures are not, of course, available on the amount of energy converted into chemical energy from sunlight, although the several estimates that have been made are all of the same order of magnitude. One set of figures gives values of $4.3 - 6.3 \times 10^{16}$ kcal/yr for the land and $4.3 - 11.8 \times 10^{16}$ kcal/yr for the sea (Kormondy, 1969). The total amount of energy used by human society and derived from coal, petroleum, natural gas and electricity in 1966 is given in the U.N. Statistical Yearbook of 1967 as the equivalent of $5{,}505 \times 10^6$ metric tons of coal. We must add to this the energy provided each year by animals, fuel wood, utilization of wind and so on, which is estimated to be in the order of 500×10^6 metric tons of coal (Woytinsky & Woytinsky, 1953). If we convert the sum of these two figures to kilocalories, and add to it the energy flow through the human population (i.e. about 3.6×10^{15} kcal/yr), we arrive at a total figure of 4.78×10^{16} kcal for the year 1966. The present figure (1970) can be expected to exceed this by at least 10 per cent, giving us a value of 5.2×10^{16} kcal.

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This means that a single species, *Homo sapiens*, is now utilising in its activities each day about as much energy as is captured by the whole of the terrestrial vegetation of this planet in the same period of time. In other words, this single species has recently come to use about as much energy as all other terrestrial animals and plants put together. It is natural, I suppose, for us human beings to look on this outstandingly significant development as something of an achievement; but let us not be so carried away by self-praise that we permit ourselves to imagine for a moment that a new force of this magnitude can be introduced into the biosphere without having the most profound and far-reaching effects on the system as a whole. Incidentally, it is the hopeful prediction of some authorities that the use of energy by man will have increased a further four to fivefold by the end of the century and fiftyfold by the year 2500 (Hammond, 1969).

Another important and unique feature of the situation today is that, partly because of their magnitude and partly because of their nature, the major environmental threats facing human beings have ceased for the first time to be restricted to certain localised areas of the earth's surface, and to certain sections of the human population. To quote from a recent document produced by the U.N. Economic and Social Council: "What were once local problems are now global in extent and call for concerted effort by the nations of the world if they are to be solved . . . it has become clear that we all live in one biosphere within which space and resources . . . are limited". This development has important ecological, and perhaps also ethical implications. It means that, with respect to certain growing environmental threats, the human species is now, in an ecological sense, a single group. Unlike the situation in the past, if this one group is unable to cope with the impending threats to its existence, there will be no other groups left elsewhere to keep the species going.

Broadly speaking, it can be said that the causes for concern in the current rapidly changing environmental situation are of two kinds. Firstly, there are the threats which result from the direct influence of certain changes, such as air pollution or crowding, on the physiology and behaviour of the human organism. Secondly, and probably more importantly, there are the effects of certain environmental developments on the ecosystems of the earth's surface on which, of course, all life, and civilisation itself, are completely dependent. The significant fact is that, just as there is a limit to the biological "adaptability" of the human organism, so is there a limit to the resilience of these ecosystems in the face of injurious influences.

I do not intend to dwell in any detail on the various manifestations of the increasing impact of civilisation on the biosphere, since most of you, I am sure, are at least as knowledgeable as I am on this topic. Apart from the massive increase in the number of specimens of *Homo sapiens* on earth and the problems that this raises in connection with food

supply* and the general quality of life, one of the most significant changes that is now taking place is the increasing degree of "chemicalisation" of the total environment. This development is due to the accumulation in the environment of the products of combustion of fossil fuels used in our rapidly growing industries and transport systems, and in part to the explosive proliferation of the chemical and pharmaceutical industries, which are now manufacturing and releasing into the environment an incredible number of new chemical compounds every year. A high proportion of these substances are biologically active and are therefore likely to affect, in one way or another, organisms and hence ecosystems with which they come in contact.

Because many of the chemical products of modern technology inevitably find their way into the oceans, either via the rivers or via the atmosphere, analyses of sea water and of marine organisms provide an interesting and meaningful indicator of the degree of chemical change occurring in the total environment as the result of human technology. There are now numerous reports, for example, dealing with the detection of biologically active substances such as the polychlorinated biphenyls (PCB) (by-products of the plastics and other industries), various pesticides, mercury and lead in the organs of marine animals from regions as far apart as the Arctic and the Antarctic. It has been estimated that some half million different chemical products of our technological society are now finding their way into the oceans† (Goldberg, 1969).

Similarly, numerous changes of a physicochemical nature have been detected in the atmosphere, and while many of these tend, of course, to be concentrated around the big cities, some, such as the increasing levels of carbon dioxide and the increasing turbidity, are world-wide.

These brief comments on the environmental situation would be absurdly incomplete without reference to the threat of nuclear warfare – a threat to which we have, with our characteristic "human adaptability" as it is called, already become accustomed. In fact, we seem to have become so adapted to this situation that even school science textbooks in use in this part of the world fail to make any reference to the fact that the developments in nuclear physics and technology have produced quite suddenly a situation of unsurpassable significance, unique in the history of life on earth. For the first time a single species has acquired the

* With regard to the question of food supply, there has certainly been some increasing optimism over recent months associated with the introduction of new strains of wheat and rice into developing areas (particularly well suited to local conditions) and the consequent increase in yield. However, there are still many people who find little cause for complacency in this situation. The shape of the world's population pyramids at the present time is alarming and appears to foreshadow a further quite unparalleled increase in population in the next twenty or thirty years. There can be little doubt that the situation with regard to food supply is, in spite of these recent developments, an extremely precarious one.

† As far as oil slicks are concerned, we in Australia must consider ourselves fairly lucky so far. Britain was hit by sixteen oil slicks last year.

means to destroy almost overnight not only all of its own kind but perhaps most of life on earth, and its communities hold the devices for producing this effect poised ready for immediate use (Calder, 1968).

As a last example to illustrate the magnitude of the impact of human culture on the biosphere, we can refer to the progressive replacement of vegetation and animal life by man-made structures and areas of erosion. The spread of the urban-industrial network with its associated transportation systems, and the effects of erosion are consuming the natural environment at an estimated rate of 780 square miles (half-a-million acres) each day (Arvill, 1967). Apart from the important ecological implications of this trend, many of us believe that by destroying the natural environment we are depriving future generations, if they exist, of a remarkable source of deep personal enjoyment and aesthetic satisfaction.

But it is not just a question of magnitude and ubiquity; another vitally important feature of the current situation is the extraordinary rate at which the processes responsible for environmental change are accelerating. This can be illustrated by the following analogy. Let us change our time scale, and imagine that the neolithic development occurred some sixteen to seventeen hours ago and that at that time a section of the human species jumped into a new vehicle that it had invented (i.e. agriculture and the domestication of animals for purposes of food production). Let us also suppose that the speed of this vehicle at a given point of time is proportional to the actual amount of energy utilised by human society – this being, as I have suggested, a reasonable indicator of the overall impact of civilisation on the biosphere. Sixteen hours ago, then, our ancestors stepped into their new invention, and set off at a speed of 1 m.p.h.; seven hours later they had gathered speed – mainly as a consequence of other groups of humans being picked up on the way, but partly as a consequence of further technological development – and were travelling at 17 m.p.h. Then the vehicle proceeded along the track for a further seven hours, by which time it had reached a speed of 40 m.p.h.; by twenty minutes ago it had picked up more speed, reaching 150 m.p.h.; by five minutes ago, it was going at 500 m.p.h.; and now, at this moment of time, it travels at 2,000 m.p.h.

The snag is that, as we shall discuss in a moment, while we have shown considerable ingenuity when it comes to increasing the speed of our vehicle, we seem to be guilty of the foolish mistake of having made it without brakes, and we have not the slightest notion how to stop it.

How serious really are the changes that are taking place in our total environment? A glance at any issue of a general science journal reveals the existence of two quite contrary trends in thinking. On the one hand, we see plenty of evidence that, in the now classical twentieth century tradition, tremendous amounts of intellectual effort and of finance are devoted to finding ways and means of further increasing the advance of technology and the use of power by man. On

the other hand, we find more and more articles expressing deep concern about the effects on the biosphere, and ultimately on mankind, of our rapidly expanding technology and population.

Many of the authors in the latter group (I shall refer to them, for convenience, as the "pessimists") are biologists – especially ecologists.* This fact is not without significance, since it is ultimately biological factors that determine the extent to which we can batter and pollute the biosphere without destroying its essential characteristics. Some of the pessimists even believe that civilisation cannot last beyond the end of the century, and that the collapse may be quite sudden, possibly through a number of currently sub-threshold effects in the ocean, the soil and the atmosphere reaching threshold levels at about the same time. Others consider that the destructive process will be a slow and painful one, but that once on its way it will be progressive and irreversible.

In contrast, there are others, of course, who put the opposite view – the "optimists". They describe these warnings as "hysterical" or "grossly exaggerated", and they label their proponents as "alarmists" and "fanatics". Not unexpectedly, human nature being what it is, the optimists are often associated with various vested interests, industrial, political or otherwise.

Thus, we have a situation in which a series of experts are predicting fates of the most serious kind for the living world and for humanity, while there are others who are announcing that there is no cause for alarm. I would like to stress that this pattern seems to me to be completely predictable; whenever in the history of our species individuals or groups of individuals have warned of impending disaster or have drawn attention to conditions which threaten human welfare, they have invariably been countered by others who have tried to ridicule their ideas. But here the usefulness of the historical comparison ends, for while the pattern up to this point is constant – that is, that the pessimists will inevitably be contradicted by optimists, the rest of the picture is very variable. Sometimes the pessimists have turned out to be wrong, but sometimes, like Cassandra herself, they have proved right.

As far as contemporary society is concerned, the relevant point seems to be that a group of serious and learned men are warning us of eco-catastrophe – and in my view the case is very strong for listening to them attentively. Let me put it like

* It is interesting to note that we are beginning to see some intellectual interaction between natural scientists and social scientists in this area. An example is provided by the discussion prompted by the now oft-quoted paper by the ecologist, Garrett Hardin, which was published in Science in 1968 under the title "The Tragedy of the Commons" (Hardin, 1968). In this paper Hardin deals specifically with the population problem, and paints an extremely gloomy picture of things to come; but he does hold out some hope for the future of mankind, provided that society reacts with sufficient swiftness and vigour, and introduces certain measures which he believes could save the situation. In a later paper entitled "A New Look at the Tragedy of the Commons", his views were criticised by a social scientist, Beryl Crowe, who, although she finds no fault with Hardin's biological predictions, considers that the possible solutions that he offers are simply not workable. In other words, it would seem that she sees no hope at all for the future (Crowe, 1969).

this: If a number of apparently highly qualified or intelligent experts inform you that they have reason to believe there is a time-bomb in your sitting-room, while others respond by telling you that it is a false alarm – to which group do you pay heed? I am sure that most of us would agree that only an idiot would not take some sort of vigorous action. In other words, in the light of the straight facts that we have before us concerning the magnitude and rate of environmental change, and in view of the nature of the warnings coming from these learned men, our society would be guilty of the greatest possible negligence if it did not take action immediately and on a scale proportionate to the immensity and seriousness of the problems. In fact, if things turn out to be only half as bad as some of these scientists are predicting, there is far more danger in the environmental situation than there has been in any war that this country has ever faced.

Clearly, the problems arising from accelerating environmental change are not simple ones to solve. On the contrary, it would seem that the degradation of the environment in all its various aspects is in essence a manifestation of a world-wide and apparently autonomous set of processes over which we seem to have little if any control. In the words of Nigel Calder:

> "The impression is that we are passengers in a runaway train, hurtling faster and faster along a track. Some passengers try pulling the alarm signal, but nothing happens; there seems to be no one in the driving cab. We do not know where the track eventually leads, but the direction is apparent for the time being. It carries us towards new weapons, new industries, new mechanical and electronic products, new drugs, new pollutants, new sources of noise; it takes us away from nature and the simple life. Other trains on the line represent the different nations; some are far behind, but they are all going the same way. There seems to be no escape, no diversion open. 'You can't stop progress, people say'". (Calder, 1969).

I will not attempt to analyse here these complex self-perpetuating, self-expanding and self-accelerating processes but will refer very briefly to the most important ones. Firstly, there is what we can call the techno-demographic vicious circle – or perhaps more appropriately, the techno-demographic vicious spiral. This term refers to the fact that the conditions of civilisation and associated technological developments have permitted an explosive increase in the human population and indeed, the present four thousand million people on this earth could not possibly be supported without modern technology. As this population continues to increase, further technological advance is called for to alleviate hardship in under-privileged and over-populated areas. This new growth of technology, industry and food production permits a further increase in population to the limits of human tolerance – so that once again increased productivity is called for to alleviate human misery. And so the process goes on. It is characteristic of this techno-demographic spiral that a significant section of the world's population should always exist under conditions incompatible with proper

self-fulfilment and enjoyment of life.

Another related and very important spiralling process is that driven by the economic competition between nations, a process which dictates that every industrial country shall put increasing effort both into producing more and more manufactured goods and into continual technological innovation, thus contributing increasingly, of course, to the contamination and degradation of the biosphere. The policy statements of our own government (and probably of all other governments) clearly show this to be the declared aim of the nation. A parallel process, of course, is the arms race, the inevitability of which seems to be accepted by the mass of humanity.

Contributing to the factors tending to boost these spiralling processes is the implicit creed of our culture that there is something virtuous and praiseworthy in technological advance and industrial growth in their own right – "growthmania" as it has been called by E.J. Mishan (1969), one of the small number of economists who has expressed concern about these trends. I think it is true to say that for the vast majority of people in modern Western society, any new technological development and any further modification of the environment is looked on as a sign of human "progress", and as such is regarded as laudable and desirable. I suggest that this statement applies particularly to Australians, with the possible exception of the Aborigines – whose attitudes on these matters we are doing our level best to change as quickly as we can. Of course, we hear the plaintive cries of minority groups complaining of disturbances in their local spheres of experience, but little heed is paid to them on the whole; and anyway, in most cases they eventually accept the changes as "the price to be paid for progress".

Now, it is abundantly clear to every thinking person that this series of spiralling processes must, at some point of time, come to a halt; for there are limits to both the optimum and the maximum number of people the earth can support, and there is a limit to the amount of chemical garbage we can throw out into the biosphere before it becomes choked beyond recovery. It is also obvious that these spirals could stop as a consequence of a catastrophe or a series of catastrophes which might eliminate mankind from the face of the earth, or at least destroy civilisation and most of the human population. Alternatively, the spirals could, in principle, come to a halt through being brought under control by foresight and wise planning on the part of human beings themselves.

Of course, if ecological catastrophe is to be avoided, people will once again have to accept a situation similar in certain important respects to that which existed during tens of thousands of generations before the beginning of civilisation, and indeed until quite recently – a situation, that is, in which continuing "progress", in the technological and industrial sense, is neither a feature of human society nor seen as a desirable end. In other words, mankind will have to reject the growth-and-production gospel and accept a social system that does not involve a

continually thrusting technology, perpetual economic growth and an ever-increasing population. The conclusion is inescapable that such changes in social aspirations are essential if our species is to survive for any length of time, and if our descendants are to enjoy life on earth for as long as the climatic conditions determined by the state of the sun allow. Some people will argue that such a reversal of attitude is impossible because it would be, they believe, entirely "against human nature"; in my opinion this view is nonsense. The prevailing attitude of contemporary Western society that man must continually be directing his talents towards more specialised scientific research, further technological innovation, and greater industrial and economic development is purely a cultural phenomenon, and as such is due entirely to learning and conditioning in early life. In this country, it is fostered deliberately and continually during the education of children at the primary and secondary levels; and if anyone doubts this assertion, I suggest that he has a careful look at the textbooks used for teaching science and social studies in our schools from this point of view. As I have indicated, continual innovation and economic growth were not features of human society for the tens of thousands of generations of mankind that preceded the technological revolution. People were content to use the tools and methods that were passed on to them by their parents and grandparents and that had been used for many thousands of years. I would agree, of course, that the desire to accept and seek physical and intellectual challenge seems to be an inbuilt characteristic of the human species, and it certainly would have been of great survival value in our evolutionary history. But there are ways and means of satisfying this tendency other than through technological advance, industrial growth, and increasing devastation of the natural environment.

By stressing the necessity for society eventually to accept again a "non-progress" or "steady-state" situation, I do not intend to imply that we must reduce our numbers to those of the Stone Age, nor that we should return to the patterns and conditions of life of that era. I suggest that civilisation could continue to exist and to provide our potential descendants with a full and satisfying way of life; but this will be possible only if the present runaway processes of civilisation are brought quickly and firmly under control.

The critical question, then, is whether we, as the single group which we now are in the ecological sense, will come to recognise the magnitude of the environmental threats before they cause irreparable damage, and, even if we do this, whether we can muster sufficient wisdom, imagination, international understanding, political tolerance and strength of purpose to achieve a solution in time.

In this connection, I would like to emphasise the opinion that the solution to the great environmental threats facing man today definitely does not lie simply in the further intensification of specialised scientific research and further technological advance. This viewpoint has, of course, been expressed by many

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writers, both scientists and non-scientists, who have concerned themselves with these matters. For example, with regard to the arms race, Wiesner & York (1964) have stated: "It is our considered professional judgement that this dilemma has no technical solution. If the great powers continue to look for solutions in the areas of science and technology only, the result will be to worsen the situation"; and with respect to other aspects of the environmental situation, the historian Lynn White (1967) has said: "I personally doubt that this disastrous ecological back-lash can be avoided simply by applying to our problem more science and technology . . .". Garrett Hardin (1968) has attacked what he calls the "implicit and almost universal assumption of discussions published in professional and semi-popular scientific journals . . . that the problem under discussion has a technical solution"; and the same view also provides the theme of a book "Science and Survival" by Barry Commoner (1967). Nevertheless, in society as a whole, only a small minority appears to believe that the various threats to human well-being cannot easily be overcome by further research and the application of technology. I have recently had occasion to read some of the science textbooks in use in Australian schools, and it was very discouraging to find, again and again, statements to the effect that any problems that modern man may have will be solved simply by putting further effort into scientific research and technology. I find it incredible that those who should be providing youth with a proper understanding of the human situation in perspective, and with an awareness of the nature of the problems facing society today, should be trying to transmit such naive and misleading ideas to the rising generation.

The suggestion that all our problems will be solved through further scientific research is not only foolish, but in fact dangerous – for it implies that the man in the street, and indeed anyone who is not a scientist, has no role to play, nor any special responsibility in these matters. As I stressed above, the environmental changes of our time have arisen out of the tremendous intensification of the interaction between cultural and natural processes. They can neither be considered as problems to be left to the natural scientists, nor as problems to be left to those concerned professionally with the phenomena of culture. They depend for their solution on our understanding of both sets of processes, cultural and natural, and especially on the way they interact together. That is to say, they depend on the wise use of knowledge acquired in the natural sciences, social sciences and the humanities, and on long-range and intelligent planning based on this understanding.

The question of where in society lies the responsibility for doing something about this situation is one that is receiving far too little attention. However, when we do come to consider this point, it seems clear that, while all sections of the community have a role to play, certain key groups have, at the present time, a special responsibility. Because so much depends on a rapidly widening understanding of the nature of the environmental predicament and of the

socio-biological processes that are threatening the biosphere and civilisation, it is clear that our educational institutions must be placed at the top of the list of key groups with special responsibilities.

Other speakers in this Conference will deal, no doubt, with the ways and means by which educators are helping, or could help the situation. Since I have the floor now, however, I will take the opportunity to make a few points relating both to education at the primary and secondary levels and to the role of tertiary institutions. Firstly, I suggest that in schools much deliberate and co-ordinated effort should be directed towards providing courses which:

1. present students with a comprehensive picture of the human situation in biological and historical perspective;
2. give a true and balanced picture of the effects of science and technology on human society and on the biosphere;
3. provide the student with an awareness of the current serious threats, as scientists and others see them, to the well-being and survival of the species;
4. avoid the implication in teaching that all the answers to any problems that man may have lie simply in further intensification of scientific and technological effort;
5. introduce the student to the concept of the constant interplay between cultural and natural forces;
6. stimulate thinking and discussion on the social and biological problems of mankind.

In my view, education in primary and secondary schools in Australia at the present time fails completely to achieve these elemental objectives.

In principle, two approaches towards the achievement of these aims are possible. Firstly, in each academic discipline, the objective should be to impart information and stimulate thinking on the important principles and ideas that have come to light in that discipline, especially as they relate to problems of human society and to subject matter of other disciplines. More deliberate integrative effort of this sort could help considerably to counter undesirable effects of the fragmentation characteristic of the present curriculum. Secondly, thought should be given to the possibility of introducing a core subject into the school curriculum aimed at providing an integrated and coherent picture of "Man in the Biosphere", dealing with the history of life on earth, with the biological and cultural history of our species, with the successes and failures of our ancestors and of our own generation, and with the principles that govern cultural and natural processes, especially as they relate to the problems of human society and the interaction between these processes.

Turning to the tertiary institutions, it is my opinion that they are in large part responsible for the deficiencies in education at the primary and secondary levels in Australia. Moreover, they fail themselves to turn out any graduates who have a

comprehensive and balanced knowledge of mankind, past and present, against the global background. The universities have not only allowed the development of the so-called "two cultures" – that is, the separate development of the intellectual disciplines concerned with the processes of human culture on the one hand and those concerned with the processes of nature on the other – but they have actually encouraged the perpetuation of this deceptive and damaging dichotomy. Let us agree at once that the processes of nature and those of culture are different in many ways; but it is essential that we appreciate also that the future survival and well-being of mankind depend entirely on our proper understanding of the principles that govern the *interplay* between these two sets of processes.

Extraordinarily little effort has been made in the universities to resist the pressures which are tending to push young minds earlier and earlier into narrower and narrower degrees of specialisation. This, of course, is a complex question which could be debated at great length. But I would like to emphasise the point that, while increasing specialisation is necessary, no less essential is the need for this trend to be counterbalanced by disciplined intellectual effort aimed at producing better understanding of the total human situation.

More specifically, I would suggest that, in education at the tertiary level, two developments are urgently needed. They are: (1) the introduction of full degree courses which relate to the "science of man" in all its aspects and including, suitably linked together, the following subjects:– human biology (evolution, ecology, genetics, epidemiology, etc.), behavioural science, pre-history, anthropology, demography, social history, sociology and economics. The aim of these courses should be to produce graduates who have a comprehensive grasp of the knowledge that has been acquired in these various disciplines as it contributes to the understanding of the contemporary human situation in scientific terms; and (2) the introduction, for students in all subjects, of integrative courses on the human situation, aimed especially at relating the subject matter of specialised courses to the problems of human society.

Let me summarise, then, the main points that I have been making:

1. As a consequence of the techno-demographic, economic and military escalatory spirals, civilisation is having a massive impact on the natural resources of the world (living and non-living) on which all life depends. Because the effects of this interaction are now for the first time world-wide, we have become, ecologically speaking, a single group.
2. At some point of time, or rather at some point of development, these self-perpetuating spirals must cease – for the world and its resources are finite, and there are limits to the resilience of its ecosystems and to the biological adaptability of the human organism.
3. Many experts believe that the danger point has already been reached. They believe that disaster on an unprecedented scale is not far away. Predictably,

others label these claims as gross exaggerations, and their proponents as fanatics and alarmists.

4. Whichever of these groups we belong to, we must accept the fact that there is no doubt that, as we approach the limits of tolerance of the biosphere, the processes which are leading us towards them are continuing to gain momentum and speed.
5. Whatever the optimists may say, one thing is certain – we simply do not know how to stop these spiralling processes when we want to. Nor do we know how to slow them down. The inescapable truth is that we are not in control.

In spite of this very grave deficiency in our know-how, world society is putting increasing effort into further accelerating these processes.

These seem to me to be plain, undebatable facts. I have not made any predictions myself. But with regard to the future, my own views can be summarised as follows: Because of the very serious nature of the warnings that are being uttered, and because of the ubiquity and magnitude of the environmental changes that are taking place, these ecological threats dwarf in importance the more local problems, such as drug abuse, increasing rate of crime, cardiovascular disease, boredom and so on (although indeed many of these are in fact manifestations of the same autonomous spiralling cultural processes). I think it is possible that civilisation and its human components may be saved from ecological catastrophe; but I am personally convinced that nothing short of a great wave of new thinking sweeping through all sections of the community can possibly bring these spiralling processes under control in time to avert major global disaster. This wave of new thinking must involve also to some extent a *new morality*, one of the characteristics of which must be a genuine and heartfelt concern both for the *survival* of that unique product of the long evolutionary process, *Homo sapiens*, and also for the *quality* of the lives of our potential descendants.

The great challenge that faces the rising generation today is to sort out the mess that has been created by their forefathers, to unravel the complex interrelationships between the factors threatening the total environment, and to work out and implement, before it is too late, plans for protecting the biosphere, civilisation and future generations of mankind. The great challenge to the present adult generations is to provide youth with an education that will prepare them emotionally and intellectually for this gargantuan task.

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A STRATEGY FOR CURRICULUM DEVELOPMENT AND IMPLEMENTATION IN ENVIRONMENTAL EDUCATION AT THE ELEMENTARY AND SECONDARY LEVELS. By William B. Stapp*

Environmental Education in the School Curriculum

Today's youth in elementary and secondary schools will soon be assuming important roles as adult citizens in society. As citizens and voters, no matter what their occupation may be, they will be asked to make decisions that will affect not only the immediate environment in which they live, but also that of their country. To an increasing extent the votes they will cast and the choices they will make will be concerned with their environment. They will be asked to make social and economic decisions about recreation, transportation, beautification, water needs, and air and water pollution control. Since these issues affect the total environment in which we live, we must assist our young people (and adults) to acquire the experiences, knowledge, and concern necessary for making informed environmental decisions.

In our political system we depend upon the wisdom of individuals of the populace for making decisions. A major responsibility for assisting future citizens to obtain the knowledge and incentive necessary to make informed decisions has been delegated to school systems. Since environmental education is essential to our type of political system, it is important for the public to ask whether or not school systems are effectively fulfilling their responsibility to society.

Dr Arthur D. Barfield, Director of the Conservation Material Center, University of Massachusetts, recently made the following statement:

> "Despite noticeable efforts on the part of communities and states to develop wholesome environmental attitudes and habits, it is common knowledge that much remains to be done in this direction. While radio, television, and various printed materials provide information pertaining to the wise use of our environment, we cannot rely upon or expect these media to accomplish the ultimate objective – the development of life-long environmental understandings by the American public. It remains, then, that an approach is needed which will not only guarantee the dissemination of accurate information, but the installation of desirable attitudes and understanding of environmental education as well. Some experience has demonstrated that we must teach with these objectives in mind and not leave their realization merely to chance. It goes without saying that the schools offer the most natural and logical setting for meeting this end.
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> "Ironically, our educational institutions now play, at best, a minor role in the environmental education movement. Traditionally, some schools have attempted to integrate environmental education into the existing curriculum while others have made progress through offering environmental education courses *per se*. Whatever the

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approach, available evidence suggests the need for greater emphasis upon this phase of the child's education."

One of the most important challenges of education today is to develop an effective method of implementing environmental education in elementary and secondary school systems.

A Strategy of Curriculum Development

If individuals are to be prepared to make the kind of environmental decisions that our nation will face in the future, schools must embark on a comprehensive environmental education program that will span the curriculum, kindergarten through the twelfth grade (K–12), and link subject areas that relate most closely to the environment.

The information that follows reflects the author's eight years of experience in serving as conservation consultant with the Ann Arbor Public School System; his participation in a graduate seminar in environmental education at the School of Natural Resources, the University of Michigan; and a comprehensive review of the literature.

A School system (K–12) that is interested in developing an *environmental education program* might consider the following strategy:

Phase I: Identify the *need* for developing the program

Phase II: Establish an environmental education *committee* to develop and implement the program and to facilitate communication

Phase III: Establish the *goal* and *sub-goals* of the program

Phase IV: Establish the *objectives* (in terms of behavioral predispositions) of the program

Phase V: Review of the literature regarding *theories of learning and instruction* that apply to the formulation and implementation of the program

Phase VI: Establish the *curriculum organization* of the program

Phase VII: Establish the *curriculum* of the program

Phase VIII: Establish a comprehensive in-service *teacher education* program

Phase IX: Develop instruments to *evaluate* the effectiveness of the program

Phase I: The Need for Developing an Environmental Education Program

Within the past fifty years, the United States has become a predominantly urban nation, both in thought and in physical character. Large and middle-sized communities, many within complex urban regions, have evolved to a point where over seventy percent of this country's population resides on one and one-half percent of the nation's land surface. By 1980, eight out of ten Americans will probably live in an urban environment. Consequently, the independent rural-oriented living that once characterized this country's social and political heritage is no longer a dominating influence in the lives of most Americans.

In rural surroundings, direct daily contact with the basic natural resources was prevalent, especially within man's immediate environment. As man became progressively urbanized, his intimate association and interaction with natural resources diminished and, with it, his awareness of his dependency on them. Yet, it is imperative that man, wherever he lives, comprehend that his welfare is dependent upon the "proper" management and use of these resources.

Man should also have an awareness and understanding of his community and its associated problems. Our communities are being plagued with problems such as lack of comprehensive environmental planning; indiscriminate use of pesticides; community blight; air and water pollution; traffic congestion; and the lack of institutional arrangements needed to cope effectively with environmental problems. While these problems are legitimate concerns of community governmental officials and planners, the responsibility for their solution rests, to a large extent, with citizens.

To an increasing extent citizens are being asked to make decisions that affect (directly and indirectly) their environment. Specifically, citizens make these decisions as they *cast votes* on community issues; as they *elect* representatives to policy-making bodies; and as they directly act upon the environment itself. Citizens can be effective in influencing sound policy in other ways. They can ask informed questions, at the proper time, of the right people. They can serve on advisory and policy-making committees. They can support sound legislation directed at resolving environmental problems. To perform these tasks effectively, it is vital that the citizenry be knowledgeable concerning their biophysical environment and associated problems, aware of how they can help solve these problems, and motivated to work toward effective solutions.

The Supreme Court decision regarding the one-man, one-vote concept, that has enabled the increasing urban majority to acquire greater powers in decision-making, makes it imperative that programs developed for urbanites be *designed with them in mind*. It is important to assist each individual, whether urbanite or ruralite, to obtain a fuller understanding of the environment, problems that confront it, the interrelationship between the community and surrounding land, and opportunities for the individual to be effective in working toward the solution of environmental problems.

Most current programs in conservation education are oriented primarily to basic resources; they do not focus on the community environment and its associated problems. Furthermore, few programs emphasize the role of the citizen in working, both individually and collectively, toward the solution of problems that affect our well-being. There is a vital need for an educational approach that effectively educates man regarding his relationship to the total environment (Stapp, 1969).

Phase II: Establish an Environmental Education Committee to Develop and Implement the Program and to Facilitate Communication

An essential component of most successful school programs is effective communication between the community and school system.

The introduction of any new school program requires the involvement and preparation of the community, administration, teaching staff, and student. One reason many well-conceived programs have failed is because teachers and students were not involved in program development.

In developing an environmental education program, it is important that an environmental education committee be formed to develop and implement the program and to facilitate communication between the community and the school system. The committee should consist of elementary teachers (representing each grade level), secondary teachers (representing each discipline), school administrators, community citizens, and students. The environmental education committee should report to the superintendent of schools (or to an individual or committee designated by the superintendent).

In developing an environmental education program for a school system, it is strongly recommended that an environmental education consultant *position* be created. The environmental education consultant could provide the leadership and guidance essential to the success of any program. One of the major responsibilities of the environmental education consultant would be to assist in the development and implementation of the in-service teacher education program.

Some important duties of the environmental education committee would be to:

1. Assist in the development of the philosophy and structure of the program.
2. Become familiar with existing instructional material relevant to environmental education.
3. Identify community resources, both physical and human, to serve the program.
4. Assist in the development and distribution of instructional material (such as environmental encounters).
5. Provide a comprehensive in-service teacher education program.
6. Train community citizens to serve the program.
7. Assist in the development of school sites to serve the program.
8. Administer the program.
9. Make presentations to parent-teacher and other community organizations regarding the program.
10. Evaluate the effectiveness of the program in achieving stated objectives.

Phase III: Establish the Goal and Sub-Goals of the Environmental Education Program

Without a clear statement of goals, an environmental education program would become a series of unrelated experiences, focusing perhaps on limited program objectives.

The goal of environmental education is to produce a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, aware of *how* to help solve these problems, and motivated to work toward their solution.

The major sub-goals of environmental education are to help individuals acquire:

1. A clear understanding that man is an inseparable part of a system, consisting of man, culture, and the biophysical environment, and that man has the ability to alter the interrelationships of this system.

   The principal feature of the philosophy of environmental education is that man is an integral part of a system from which he cannot be separated. Specifically, this system consists of three components, man, culture, and the biophysical environment. Culture, in this context, incorporates organizational strategies, technological processes, and social arrangements (political, legal, managerial, educational, etc.) through which man interacts with the biophysical environment. The biophysical environment designates both the natural and man-made components of the environment.

   The fundamental relationship between the integral parts of the system is man's interaction through culture on the biophysical environment to produce or obtain the goods and services that he needs.

   Within the system, man has the ability either to strengthen, weaken or maintain the interrelationships between the system's major components. A major thrust of environmental education is the development and maintenance of a high quality system in which man interacts through culture on the biophysical environment to advance human welfare.

2. A broad understanding of the biophysical environment, both natural and man-made, and its role in contemporary society.

   The existence of any civilization is dependent upon man's use of natural resources. Resources are defined as those parts of the biophysical environment which are appraised by man as being immediately or potentially useful to him.

   A basic understanding of natural resources ideally includes their characteristics, distribution, status, interrelationships and their present and potential uses. Natural resources serve man in many ways, whether

in a relatively undisturbed condition or in the highly altered utilitarian forms of the man-made biophysical environment. A strong understanding of how these resources are used requires knowledge of the social, political, economic, technological processes, institutional arrangements, and aesthetic considerations which govern their utilization.

Man's use of natural resources comprises the man-made component of the biophysical environment. An understanding of this aspect is also essential: it should ideally include familiarity with urban and rural design, including transportation systems, spatial patterns of development, and aesthetic qualities which have a major impact on the functioning of society. Fundamental to these understandings should be the realization that the development of the man-made environment should strive for a high quality system which improves human welfare in relation to the natural environment.

3. A fundamental understanding of the biophysical environmental problems confronting man, how to help solve these problems, and the responsibility of citizens and government to work toward their solution.

   Biophysical environmental problems result from the interactions between man, culture and the biophysical environment. Pollution, the inefficient utilization and management of natural resources, the indiscriminate use of pesticides, urban blight, and transportation congestion are just a few biophysical environmental problems. These problems, caused by a complex set of biological, physical and social factors, affect the total environmental system.

   Citizens need to understand how to work toward solutions of biophysical environmental problems through laws, public policies, planning, resource management, research, technological developments, and institutional arrangements.

   Citizens should realize that the responsibility for solutions to these problems belongs to them and the governments which represent them.

4. Attitudes of concern for the quality of the biophysical environment which will motivate citizens to participate in biophysical environmental problem-solving.

   The word "attitude" used in this context implies more than simply the knowledge of a body of factual information. Instead, it implies a combination of factual knowledge and motivating emotional concern which result in a tendency to act. Further, it is understood that clusters of attitudes about similar environmental conditions will collectively produce values which will motivate individuals to express their attitudes. Therefore, for environmental education to achieve its greatest

impact, it must: (1) provide factual information which will lead to an understanding of the total biophysical environment; (2) develop a concern for environmental quality which will motivate citizens to work toward solutions to biophysical environmental problems; and (3) inform citizens as to how they can play an effective role in achieving the goals derived from their attitudes.

Phase IV: Establish the Objectives (in terms of behavioral predispositions) for an Environmental Education Program

There are various ways to state the expected and desired outcomes of an environmental education program. Perhaps the most significant and dynamic approach is to state them in terms of behavioral predispositions. In other words, the product of an environmental education program (K–12) should be a citizen who is:

1. Interested in his environment and its relationship to society.
2. Sensitive to his environment, both the natural and man-made aspects (total awareness).
3. Sensitive to the dimension of quality in his environment and able to recognize environmental problems.
4. Inclined to participate in coping with environmental problems.

Phase V: Review of the Literature Regarding Theories of Learning and Instruction that Apply to the Formulation and Implementation of an Environmental Education Program

A recent review of the literature reveals the following points that should be considered in the formulation of an environmental education program:

1. Behaviors which are reinforced are most likely to recur. It is important that desired behaviors be reinforced by the home, school, church, youth organizations, etc.
2. The most effective effort is put forth by youth when they try tasks which fall in the "range of challenge" – not too easy and not too hard – where success seems likely but not certain.
3. Youths are more likely to throw themselves wholeheartedly into any project if they themselves have a meaningful role in the selection and planning of the enterprise.
4. Reaction to excessive direction of the teacher is likely to be: apathetic conformity; defiance; escape from the whole affair.
5. What is learned is most likely to be available for use if it is learned in a situation much like that in which it is to be used and immediately preceding the time when it is needed. Learning in youth, then forgetting, and then relearning when need arises is not an efficient procedure.
6. The learning process in school should involve dynamic methods of inquiry.

7. Research shows little correlation between cognitive achievement and concern and values. Able students who achieve well in traditional "content-centered courses" do not necessarily demonstrate commitment to positive social goals.
8. Learning takes place through the active behavior of the student. It is what he does that he learns, not what the teacher does. The essential means of an education are the experiences provided, not the things to which the student is merely exposed.
9. One of the keys to motivation is a sense of excitement about discovering for one's self, rather than having a generalization presented by a teacher and requiring a student to prove it.
10. Attitudes may not be formed through a rational process by which facts are gathered and a reasonable conclusion drawn, but rather through the repeated exposure to ideas.
11. Helping citizens to acquire technical knowledge, alone, regarding an environmental problem, may not increase their concern for the problem.
12. Citizens are more likely to become involved in environmental issues if they are aware of how they can have some effect upon decision-making.

Phase VI: Establish the Curriculum Organization of the Environmental Education Program

An important criticism of our public school system is the lack of adequate articulation between the various divisions of the school curriculum. Instead of a well developed series of instructional units and activities commencing at the kindergarten level and terminating at the 12th grade, many school systems present a series of units that have little relationship between what has previously been taught and what will be taught in future years. The K–12 approach seems to be the soundest way to plan a curriculum for environmental education.

It is important to plan curriculum projects horizontally as well as vertically. Disciplines, such as science and social studies, should not be studied in isolation. A curriculum should be planned so that students can see the contributions of interdisciplinary studies in assisting the learner better to understand the environment and to be more effective in solving environmental problems.

Furthermore, a curriculum program should recognize individual differences. There is no sequence that will meet the needs of all groups of youth. Therefore, a curriculum program should be flexible in design so that material can be presented in different ways depending on the background, needs, and aspirations of the students.

A set of guiding principles that should be considered when structuring an environmental education program are:

1. Span the curriculum, kindergarten through the twelfth grade, so that environmental experiences can be presented at every grade level, thereby

capitalizing on the cumulative effects of the program.

2. Link subject areas that relate most closely to the environment, especially science and social studies, so that both the social and scientific knowledge important in understanding and solving environmental problems are properly developed.
3. Integrate and correlate the program with the existing curriculum in a manner that will enhance the instructional goals of the school system.
4. Focus on the local environment, but do not neglect regional, national, and international environmental issues.
5. Stress attitudes and problem solving skills. The most important environmental impact that most of our urban citizens will have upon our environment is through their action as community citizens.
6. The learner should play an active role in the learning process. The learner develops attitudes through personal experiences and thinking and not through the presentation of predigested conclusions.
7. Provide a comprehensive in-service teacher education program which would operate throughout the school year and be directed at assisting teachers to increase their understanding, interest, awareness, and teaching skills in environmental affairs, and to involve them in curriculum development.

Phase VII: Establish the Curriculum of the Environmental Education Program

In establishing an environmental education program for a school system (K–12), consideration should be given to the development of a series of *environmental encounters*. The encounters should focus the attention of elementary and secondary youth on their environment, in a manner that would link relevant ecological, economic, social, technological and political information.

The environmental encounters could be designed to provide the learner with meaningful environmental experiences at each grade level, both elementary and secondary. The encounters could be used to enhance and extend an existing instructional program or to serve as the core of a comprehensive environmental education program.

Environmental encounters would provide the flexibility that a program needs to meet varying local environmental conditions and situations, as well as individual class needs.

Some examples of topics that the environmental encounters might focus upon, are: land resources, water resources, air resources, plant resources, animal resources, environmental design, environmental planning, transportation, solid waste disposal and recreation. The class could select with the teacher environmental encounters to extend an existing class unit or to serve as the central thrust of a major teaching unit.

In developing environmental encounters, the following guidelines are recommended:

1. At each grade level the learner should be exposed to *meaningful* environmental encounters that relate relevant ecological, economic, political, technological and social information. However, greater emphasis in the earlier grades should be toward developing in youth an interest, awareness, understanding and respect for the environment, and in the later years emphasis should be on "honing" problem solving skills.
2. Environmental encounters should provide the opportunity at each grade level for the learner to become personally involved in positive action toward the solution of environmental problems to which he has been exposed.
3. The learner should play a major role in both selecting and designing environmental encounters.
4. Environmental encounters should fall in the range of challenge – not too easy and not too hard.
5. Environmental encounters should involve dynamic methods of inquiry.
6. Environmental encounters that relate to environmental problems should expose the learner to the following problem solving procedure:
   a. Define the environmental problem or issue.
   b. Become informed about the problem.
   c. State the alternative solutions.
   d. Develop a plan of action.
   e. Implement the plan of action.

Every environmental encounter should contain a list of the outcomes that are desired. The outcomes desired should be expressed as *behavioral objectives*. These behavioral objectives provide: direction for the learning process; guidance in selecting content and experiences; greater focus on the learner – what the learner does; and the opportunity to appraise (evaluate) the effectiveness of a particular learning experience and of the total program. Behavioral objectives can be stated at different levels of complexity and in the cognitive (knowlege), affective (concern), and action domains.

An *example* of an environmental encounter recommended for a 6th grade class is as follows:

INVESTIGATING A POND COMMUNITY

Behavioral Objectives:

In the completion of a successful encounter, the student should be able to:

1. Draw an accurate map of the drainage area of the pond community.
2. Describe in writing four ways that the land in the drainage areas affects the pond community.
3. Draw two food chains, illustrating organisms observed in the pond community.
4. List major problems affecting the pond community.

5. Describe in writing the major steps in solving one of the problems noted in question No. 4.

Activities:

1. What is the bottom of the pond community like? How does the type of bottom affect the kinds of plants and animals found in the pond community?
2. As you look from the center of the pond community towards the shore, are there plants growing under water, on the surface, and out of the water? Why are plants important to the pond community?
3. Dip a small jar into the pond and note whether or not the water contains small organisms (these are probably plankton organisms). Why is plankton important to the pond community? What would cause plankton to increase or decrease?
4. Make or obtain a dip net and sample around the edge of the pond community. How are the animals you have caught important to the pond community? Draw a food chain linking some of the plants and animals you have noted in and around the pond community.
5. On a map of your community, colour in the land area that drains toward the pond. How has the use of this land changed over the past 15 years? What changes are occurring at the present time? How does the use of this land affect the pond community?
6. Do both children and adults visit the pond community? What do people do when they visit the pond community?
7. Do you see any problems that are affecting the pond community? Who is responsible for creating the problems? What could your class do to help solve one of the problems noted above (define the problem, become informed about the problem, state alternative solutions, develop a plan of action, implement the plan)? Is your class motivated and concerned about *one* of the problems to the degree that they desire to work toward its solution?

An example of an environmental encounter recommended for a high school American Government class, is as follows:

FLOOD PLAIN ZONING

Behavioral Objectives:

In the completion of a successful encounter, the student should be able to:

1. Draw on a map of his community the flood plains (50 year flood line) of the *(name)* River from *(location)* to *(location)* and record accurately how each flood plain is developed.
2. Describe in writing the number of floods and flood damage that has occurred on the flood plains of the *(name)* River from *(location)* to *(location)* over the past 60 years (or over the time that records have been filed).
3. Describe in writing the major provisions in the laws of his state and community regarding flood plain zoning.
4. Identify the power structure (pressure groups, governmental committees, governmental policy makers) of his community regarding who influences and makes policy on flood plain development and zoning.

Activities:

1. Take (or illustrate by slides) a tour along the *(name)* River from *(location)* to *(location)* and note the following:
   a. Are there a series of flood plains?
   b. How are the flood plains developed?
   c. Are there homes or buildings on the flood plain? Are they flood-proofed?
   d. Are there provisions for protecting the flood plains from flooding?
   e. What trends regarding land development are occurring on the flood plains of your community?

2. Seek information from reliable sources regarding the flood plains of the *(name)* River from *(location)* to *(location)* :
   a. Has flooding of the flood plains occurred during the past 60 years?
   b. List the years in which flooding has occurred.
   c. Approximately how much damage (dollars, lives, inconveniences) has occurred on the flood plains as a result of flooding over the past 60 years?
   d. What does your *State* flood plain ordinance say? If none exists, is your State considering the introduction of an ordinance?
   e. What does your *community* flood plain ordinance say? If none exists, is your community considering the introduction of such an ordinance?
   f. How is the undeveloped land on the flood plain zoned?
   g. Are there any current proposals to utilize the undeveloped flood plains of your river for recreational, residential, commercial, or industrial development?
   h. What proposals seem wise or unwise in light of the hazards you have identified?
3. Draw on a map of your community the flood plains (50 year flood line) of the *(name)* River from *(location)* to *(location)* and record how each flood plain is developed.
4. Determine by interviews the points of view of land developers, community citizens, realtors, chamber of commerce officials, planning commission members, city council members and students of your class regarding the future development of the flood plains of the *(name)* River from *(location)* to *(location)* .
5. Based on the information collected, have the class formulate alternative solutions to the development (or preservation) of the flood plains on the *(name)* River from *(location)* to *(location)* .
6. Draw a chart of the power structure (pressure groups, governmental committees, governmental policy makers) of your community regarding who influences (underline the influencers) and make policy (circle the policy makers) on flood plain development and zoning.
7. If the solution advocated by the class members is different from the point of view held by the planning commission and policy makers of your community, then develop and implement a plan of action (presentation to the appropriate authority, develop a fact sheet, publicize your position, etc.).

Each environmental encounter should also provide data regarding sources of additional information relevant to the topic.

If the environmental education program for a school system revolved around environmental encounters, a twelfth grader might *not* be exposed to all aspects of the environment. However, through the inductive (inquiry) approach advocated by this system, a twelfth grader that had been exposed to this program *should* be more sensitive to his environment (total awareness), be better able to recognize environmental problems, have more sophisticated problem solving skills appropriate to the solution of emerging environmental problems, and be more inclined to participate in coping with environmental problems than the product of other forms of instruction known to the author. The learner would also have an understanding, and should see the importance of relating ecological, economic, social, technological and political information when working toward the solution of environmental problems.

The environmental encounters should be produced by the local environmental education committee and by youth and teachers from throughout the school system. The environmental encounters produced at the local level could

be mimeographed and distributed to all schools in the system. Many school systems might need and desire consultant help to orient the local environmental education committee to the task of developing environmental encounters. However, *samples* of environmental encounters could be developed and produced by a national publishing house according to elementary grade levels (lower, middle and upper) and secondary subject-matters, General Science, American Government, Biology, Economics, Social problems, etc.). Environmental encounters produced at the national level could be adapted to meet local needs and situations by the local environmental education committee.

Phase VIII: Establish a Comprehensive In-Service Teacher Education Program

If our youth are to acquire the interest, awareness, understandings and skills essential for understanding and contributing to the solution of environmental problems, then it is imperative that our schools provide environmental learning experiences. However, few teachers are prepared in our colleges and universities to use the environment to enrich instructional goals. For this reason a comprehensive in-service teacher education program is essential to a successful environmental education program (K–12).

An effective in-service teacher education program should be developed by the local environmental education committee. An early task would be to formulate a comprehensive in-service teacher education plan, which might include the following:

1. Clear statement of objectives.
2. Time sequence regarding when offerings will occur throughout the school year.
3. Involvement of teachers in all grade levels and subject areas.
4. Development of written material and instructional aids to assist the teacher in understanding and presenting environmental information.
5. Blending of community environmental experiences with indoor presentations.
6. Provisions for experiences to occur on school sites.
7. Promotion and publicity of local collegiate offerings and scholarship programs.

The first stage of an in-service teacher training program would be to orient all teachers and administrators to the philosophy of environmental education, to the structure of the environmental education program, and to ways of effectively utilizing environmental encounters.

The second stage of an in-service teacher training program would be to plan a bus tour of the community to provide teachers with first hand experiences regarding their local environment and associated problems. Information should be provided to all teachers regarding community citizens and governmental officials

knowledgeable on the environment and available to serve the school system as resource persons on environmental matters.

The third stage of the in-service teacher training program would be to assist the teachers in finding ways to integrate environmental encounters into the school program effectively.

Phase IX: Develop Instruments to Evaluate the Effectiveness of the Environmental Education Program

It is imperative that instruments be developed to evaluate the extent to which behavioral objectives are attained and the effectiveness of the total environmental education program. An evaluation should be a continuous process involving pupil and teacher feedback.

It is imperative that the evaluative instruments be objective, reliable and valid. It should be noted that behavioral objectives provide an excellent opportunity to appraise the effectiveness of particular learning experiences and of the total program.

The evaluative instruments could be developed by the local environmental education committee.

Summary

If we are to bring urbanized man to a fuller understanding of his environment, our schools must embark on a comprehensive environmental education program. The program should be aimed at helping our youth to be more knowledgeable concerning the environment and associated problems, aware of how to help solve these problems, and motivated to work toward their solution.

One of the most important challenges of education today is to develop an effective method of introducing environmental education into our elementary and secondary school systems.

This paper provides one strategy by which a school system might develop a comprehensive environmental education program (K–12). The environmental encounters could be used to enhance and extend existing class units or to serve as the core of a comprehensive environmental education program.

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ENVIRONMENTAL EDUCATION IN AUSTRALIAN SCHOOLS.

By Beverley O'Neill*

When I agreed to prepare this report on the present situation in Australian schools, my first task was to decide what "environmental education" should include. Bearing in mind that the purpose of this Conference is to examine the role of education in the environmental crisis, I chose the following definition as a satisfactory reference point for my discussion of what is or is not being taught in our schools at present:

The overall aim of environmental education should be to stimulate a sense of individual responsibility for the physical and aesthetic quality of the total environment, and to provide a challenge for wise action based on the following:

1. A knowledge of general ecological principles, including the effects of environmental change on both ecosystems and individuals.
2. An understanding of the impact of human society on the biosphere as a result of expanding population, technology and urbanisation.
3. An awareness of the problems inherent in the changing environmental situation, including pollution of air, water and soil; environmental chemicalisation; destruction of wildlife, landscapes and resources; crowding, ugliness and noise; and the dangers of nuclear and biological warfare. There should be included a study of the mounting literature concerned with these threats to the biosphere [illegible] whole and to human well-being in particular.

With this i[illegible], I examined the primary and secondary school syllabuses of the six State education systems and sought information from the Department of Education and Science, the Directors-General of Education in each State, the Teachers' Federations, Teachers' Colleges, a number of primary and high schools chosen at random in each State, and many interested individuals.

I shall first outline the present position in each of the States, and proceed from there to some more general comments.

Tasmania

In Tasmanian primary schools, the Science course is centred on the theme "The Environment", including "Living Things", "Matter and Energy" and "The Earth as part of the Universe". The list of aims set out at the front of the syllabus includes the following (No 8): "To awaken the realisation of the wonderful

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benefits of science to the welfare of mankind and at the same time an awareness of its potential dangers" (1).

Here we have an example of a rather widespread phenomenon in Australian syllabuses – namely, a disparity between the aims and the reality. For, while this syllabus provides for topics to give the child some understanding of the nature of his environment, he may leave primary school knowing nothing concerning the potential dangers of science referred to in Aim No 8. There is no specific mention in the syllabus of any environmental problems, apart from the need for plant and animal protection, and it is apparently left to individual teachers to interpret the aims and add to the course accordingly.

There is, however, a primary Social Science syllabus at present in the trial stage in Tasmania. According to the information I received from the Education Department, "an introductory coverage is implied" in this syllabus, which was not yet available for examination.

At the secondary level, at present, there is no specific provision for environmental education in any of the syllabuses for either the School Certificate or the Higher School Certificate, and again (to quote from a letter written by the headmaster of a high school) "the awakening of interest in the environmental crisis is left very much to the discretion of teachers".

However, the syllabus of a new secondary Social Science course is being drawn up, and from 1971 this course will be taken by all students during their first four years of high school. This will contain a unit entitled "The individual and society", including "the social costs of industrialisation, pollution, noise, de-personalisation of employment" and "conservation of resources".

At present, therefore, very little environmental education is specified in Tasmanian syllabuses, but these are now being reviewed and new ones are being devised which appear to be taking into account the existence of the environmental crisis, although to what extent is not yet clear. The teachers to whose discretion most environmental education is now being left are being trained in teachers' colleges in Tasmania where there is at present no Environmental Science, but I was told that the Science and Geography departments are considering the introduction of courses.

Western Australia

In Western Australia, one of the aims of the primary Social Studies syllabus is "to develop an understanding of the effect of man's activities on his environment", but the syllabus does not refer specifically to any aspect of the adverse effects of human activity. For example, there is a section headed "Our changing world", the aim of which is "to develop an awareness of social change and appreciation of the continual world-wide progress that is taking place" (2). Thus, "change" is equated

with "progress". "Water conservation" is listed for grade 7 in primary schools. The booklet on this theme which is issued to school children deals with water as a scarce resource and with the construction of dams and irrigation systems, but it does not refer to the many problems of water pollution. The primary Science syllabus aims, amongst other things, "to develop an awareness of the impact of science on society and an appreciation of the contribution of scientists" (3). In primary schools, therefore, the discussion of environmental problems (other than the need for wildlife protection) is not provided for in the syllabuses but may (to quote the headmaster of a primary school) "arise in Current Affairs largely at the whim of the teacher".

In secondary schools in Western Australia, the syllabuses in Social Studies and Health Education provide opportunities for those teachers who wish to discuss environmental problems. In general, however, the aims and the reality seem to be unconnected. For example, the Introduction to the Leaving Geography syllabus states that "This is a course in which the modern world is studied with special reference to its natural and human resources and the interaction between man and his environment" (4). Yet this syllabus does not refer to the interaction between man and his environment which is creating the problems that bring us to this meeting today, although, again, some teachers no doubt deal with these problems at their own discretion. This same criticism applies to most Geography syllabuses throughout Australia.

There is an interest in conservation in W.A. schools and the Gould League is very active there. The Education Department has a Nature Advisory Service, and conducts special ceremonies on Conservation Day each year. In general, however, there is no firmly established policy of environmental education. I would like to quote here from a document on this subject produced within the W.A. Education Department (in reply, I believe, to my request for information on the subject):

> "There is no co-ordination of such studies through the grades, no courses, no compulsion to treat suitable topics, and no signs within the schools that specific education on the nature of environmental destruction (pollution) its effects, or measures to improve the environment is being systematically and effectively covered. It would in fact be safe to say that because of inadequate knowledge a majority of adults and many teachers are not properly aware of the social implications. The majority of teachers would respond far more effectively if some direction and more help became available".

The State School Teachers' Union of Western Australia agrees with these views and has recently written to the Education Department recommending that environmental topics should be included in primary and secondary syllabuses.

Thus, in Western Australia at present, the school syllabuses are inadequate and teacher training appears to be totally lacking in the field of environmental education. Yet there does appear to be an awareness of the need for these studies.

Queensland

The Queensland primary Science syllabus is more satisfactory. The content is directly related to the stated aims, which include the following: "To create a sense of responsibility for the conservation of natural resources" (5). The theme of "conservation" runs through this whole primary Science course, with an emphasis on the promotion of "the wise use of our natural resources for the benefit of man", and the course covers conservation of flora and fauna, air, water and soil. The degree of interest of each teacher will, of course, determine the emphasis placed on these themes, but this syllabus provides scope for generating an understanding of the environment and concern for its quality.

The secondary syllabuses in Queensland are, however, disappointing. In the social sciences, no environmental topics are specified, but opportunities no doubt exist for individual teachers to include discussion of environmental problems . In Junior Science, the grade 9 syllabus includes ecological principles, but without reference to man. I quote from the science master of a high school: "The syllabus for Junior Science does not require any learning of the situations mentioned [in your letter]. Apart from one of the texts used in the schools for Junior Science, where a few paragraphs outline these major factors under the heading 'Plants and Man', there is no way in which the topic could be reached". The science staff of another high school wrote: "In Junior Science, it [the environmental crisis] is virtually ignored because of the extensive syllabuses".

The senior years follow the Biological Sciences Curriculum Studies course, covered by "The Web of Life" (6), which is published by the Australian Academy of Science. Most senior biology students throughout Australia now use this book, which is excellent in many ways. It has a sound ecological approach, using Australian illustrations, and provides a background of ecological principles, as specified in my definition of environmental education. However, it really does not deal adequately with the ecological impact of human society or the environmental problems which are causing us so much concern. Chapter 16 is entitled "Man in the Web of Life", and one would expect this to outline the major problems. After enumerating the reasons for the population explosion, this chapter continues as follows: "The rapid growth of human populations raises one main problem: if a standard of living is to be maintained the food supply has to develop at least as rapidly as the increase of populations". There is no mention of the social consequences of overpopulation, the need for birth control, or the association of environmental deterioration with accelerating population growth. This chapter discusses the effects of agricultural practices on ecosystems, the resulting need for conservation of soil and vegetation, and the possibility of biological control of insect pests, with a reference to Rachel Carson's book, "Silent Spring". This is a very limited treatment, and is hardly calculated to make students aware of the existence of an environmental crisis, although I am sure that many teachers take the

opportunities provided by this book, to enlarge on this theme.

However, we must not forget that, especially at the senior level, teaching is of necessity directed to one end – the acquisition of that piece of paper endorsed with the magic words "Higher School Certificate" or "Matriculation", and anything that is not examinable will tend to be neglected, because of the pressure of already overcrowded syllabuses. In any case, this BSCS course is taken only by senior Biology students, who in many schools form only a small percentage of the student body. Those who do not take Biology are unlikely to receive any environmental education in their senior years.

South Australia

In South Australian primary schools, Conservation is included in grade 7 Social Studies, and is centred on the observance of Conservation Day in the third term each year. However, in general, the problems of environmental deterioration are (to quote from a letter written by the Director-General of Education) "raised incidentally and discussed in primary schools during appropriate topics in Science and Social Studies". A headmaster of a primary school wrote as follows: "My personal opinion is that the matter of increasing environmental deterioration is serious enough, even in South Australia, to warrant the careful attention of those responsible for the planning of our Social Studies courses, so that it is no longer left to the discretion of individual teachers whether to study it or not". The phrase "even in South Australia" is, in my opinion, a revealing one, and I shall return to this point later on.

In secondary schools (and here I quote again from the Director-General of Education), "No systematic study of environmental sciences is made in either the Science or Social Studies curriculum . . . , but incidental reference is made to such problems as air pollution, flora and fauna conservation, soil and water conservation, the protection of the Adelaide Hills from quarrying and real estate interests, the contamination of water supplies and the harmful effects of overcrowding in cities". The headmaster of a high school wrote: "Nothing has been specifically written into the General Science course for the first three years, but there would be many opportunities for interested teachers to refer to pollution and allied topics . . . [In Social Studies] general studies of communities would involve some reference to environmental deterioration . . the depth would depend on teacher interest and encouragement". According to the South Australia Institute of Teachers, "[Some] teachers of Science, English, Geography and Social Studies refer to these problems as they arise from the prescribed syllabus . . . Other teachers tend to follow the prescribed syllabus rigidly".

In South Australia, therefore, there is no specific inclusion of environmental education in syllabuses, and at present it is being left very much to the discretion of individual teachers. It is encouraging to see, however, that some of the South Australian Teachers' Colleges are including environmental studies in their curricula.

Victoria

In Victoria, to quote the Director-General of Education, "much of this [environmental education] is provided incidentally in the teaching of Biology, Nature Study and in discussion of current problems". There is a section on Conservation, including mention of water and air, in the primary Science syllabus.

At the secondary level, in the Technical High Schools, which are attended by about one quarter of the students, there is a compulsory course on Conservation in the 4th year syllabus. The preamble to this syllabus states that: "Because of the tremendous population increase, together with rapid technological advances in modern times, man is now threatening his own extermination" (7). This course, which includes general ecology, appears to fulfill some of the requirements of my definition of environmental education. The Victorian Universities and Schools Examinations Board Handbook, which outlines the courses on which the Leaving and Matriculation examinations are based (8), does not appear to make any specification for environmental education in any subject. However, the "Web of Life" Biology course provides some opportunities (already referred to) for teachers to stimulate interest in the biological and social implications of man's impact on the earth.

At the junior level, there is no set syllabus, but many schools follow a course suggested by the Science Standing Committee of the Victorian Universities and Schools Examinations Board (9). This includes a study of "man's impact on the world and the problems to be faced" including the population explosion (causes and possible methods of control), air and water pollution, etc. This specification of "the population explosion – its causes and possible methods of control" is the only one that I have found in an Australian syllabus. As this problem is a key factor in the environmental situation, it seems to be an astounding omission from school curricula. Surely the fact that some aspects of the problem are controversial should not prevent its intelligent discussion in our schools. Nevertheless, I am sure that there must be many teachers who do make certain that this important issue receives attention.

It would seem, therefore, that some environmental education is at present provided in some Victorian schools, although the actual presentation of the material must depend upon the degree of knowledge and concern of the teachers. Yet according to information supplied by the Education Department, no specific environmental studies are included in teacher training in Victoria. *

* I have since learned of a very interesting course, covering aspects of the environmental crisis, which has recently been introduced at the Bendigo Teachers College.

New South Wales

In New South Wales the Natural Science syllabus for primary schools includes among the basic concepts set out in its Introduction the following: "Man and other living things are interdependent; the continued existence of man and other living things depends on conservation and the wise use of natural resources. Boys and girls should have a feeling of responsibility for their environment and the living things in it" (10).

The area within a mile radius of each school has been declared a faunal district, and the school grounds are therefore sanctuaries. Activities associated with flora and fauna conservation are supposed to be related to this, and the Department has appointed an Adviser in Conservation who is available to help teachers in all aspects of conservation education, including fieldwork. He has produced a suggested syllabus for conservation education as a guide to teachers, which aims to integrate the teaching of conservation, in place of the present unco-ordinated treatment in a number of subjects at different levels. This suggested course has recently been published in the "Education Gazette" (11) and a more systematic approach to conservation education may perhaps result, if many individual teachers adopt it. However, at the present time the situation in both primary and secondary schools is very similar to that prevailing in other states.

The Junior Science course is covered by the Nuclear Research Foundation Integrated Science text book – better known as "Messel" (12). This book contains 1040 pages and has the disadvantage of being very heavy to cart around in a school bag. Another more serious disadvantage is the fact that it contains practically nothing related to the environmental crisis.

There is a two page section on "Problems of the future", which begins by describing the present rate of population increase and continues as follows: "Our descendants will face many serious problems. Perhaps the answer will be great migrations to the nearest earth-type planets. Perhaps the answer will be family planning. But these sorts of solutions are far in the future" (13). It goes on to describe some possible ways of increasing the food supply of the world to feed the 6-7,000 million people likely to be alive in the year 2000 – for example, farming of the sea, and concludes: "The big problem, however, is that the scientists of the world have not really got together to solve the food problem. Nothing has been done on a world scale".

The implication seems to be that the young people can sit back and relax, because the scientists will eventually get together and solve all the problems. Moreover, the whole book contains only one small paragraph which mentions any of the serious problems which the world now faces as a result, albeit unintentional, of the work of scientists. There is, by contrast, a very quaint description of the pure motives that guide scientists: "The pure scientists . . . are essentially explorers, urged by a great curiosity to unravel more and more of the secrets of nature. The

satisfaction derived from the conquest of new fields, the obtaining of a deeper understanding of nature, provides the reward to these scientists for their endeavours" (14).

This book also expresses the hope that students will acquire the scientific spirit of enquiry; "It is in this way that you will be able to appreciate to the full all the major scientific discoveries that are certain to be made during your lifetime, and which will contribute to the services which science makes to the community in which we live" (15).

It is not surprising, therefore, to find that the syllabus for Junior Science, which this book covers, pays little attention to the problems of environmental deterioration resulting from scientific and technological progress. There is a strong emphasis on the many beneficial aspects of scientific progress and on the apparently unlimited prospects for the future. For example, there is a section in the syllabus on "Man's unique place in nature", which describes how man can alter his environment to suit his needs, and how some day he may learn how to populate other planets. No doubt, even with a course like this, many teachers manage to convey to their pupils a concern for the quality of the environment.

At the senior level in New South Wales, the Biology course has an ecological emphasis, but there is only one small section which deals with man and his impact on the earth. Strangely enough, this section is somewhat fuller at third level than at first or second levels. At first level, it is suggested that one period (i.e. forty minutes) out of the 725 periods in the two-year course should be allocated to the section "Conservation and the survival of man", including "the need to conserve flora and fauna, the desirability of preserving wilderness areas and the requirements if man is to survive in the face of expanding populations, diminishing resources and damage from radiation, pesticides and other hazards of modern civilisation" (17). At the 2S level, even this one period has been cut out. This same syallabus suggests that five periods should be spent on the topic "communication in bees", and it is significant that in last year's Higher School Certificate examination paper, a question was devoted to "communication in bees" but no question could be said to refer to man's impact on the biosphere. In fact, of all the Australian public examination papers for the last two years which I have managed to see, there were only two questions which referred to problems of the environment.

Having given a general outline of the situation in each state, I can make the following **summary**: At present, some conservation education is included to a greater or lesser degree in primary school syllabuses in Australia. At the secondary level, with its fragmentation into specialised subjects, the Geography and Social Studies syllabuses are inadequate, and although many Biology syllabuses have an ecological emphasis, most of them give scant attention to the problems arising from the impact of human society. In fact, referring to my original definition of environmental education, it must be clear that there is, at

present, no State in which a specific and co-ordinated syllabus has been devised with the purpose of producing a generation of young people who are educated to understand the ecological implications of the environmental situation, and also motivated to believe that environmental quality in its fullest sense must be restored and conserved. Although this situation is deplored by many teachers, the State Education Departments apparently are not aware of the magnitude and urgency of these environmental problems or of the importance of the role of educators in dealing with them. In this connection, it is unfortunate that, although invitations were issued to each of the six State Directors-General of Education to attend this Conference as guests of the Organising Committee, or to send a representative, none accepted and only three (Tasmania, South Australia and Victoria) have sent representatives.

This apparent failure of our educational authorities to react in a positive way to the environmental crisis stems partly, I believe, from a tendency for Australians to feel that these problems really concern other people in other places. This point was also raised by a number of headmasters who wrote to me, stressing the fact that "even in Australia" there is need for concern. I must say that, as I sat writing this paragraph in a wild and beautiful stretch of country only thirty miles from this Academy, it was very hard to imagine that this world is facing an environmental crisis. However, "even in Australia" we have pollution of the air, rivers and beaches around our industrial centres, the ugliness of many man-made landscapes, the increasing destruction of the countryside and of resources, and many other symptoms of environmental deterioration. In any case, environmental quality must now surely be viewed as a world-wide cause for concern in which all communities are involved, however isolated they may seem to be.

Nevertheless, it is apparent that, at present, most of the environmental education in our schools is being given at the discretion of individual teachers. There are many teachers who are deeply concerned and aware of their responsibilities in this area, but, equally, there must be many who, for various reasons, do not feel this concern. They are not likely to notice that the syllabuses on which they base their lessons are deficient, let alone try to impart to their students the basis of environmental ethics. Even those teachers who are convinced of the need for environmental education must be affected by the pressure of examinations and the necessity to fulfill the prescribed syllabus requirements. It is a regrettable fact that "communication in bees" (which is extremely interesting) has priority at present over "man's impact on the earth" (which is not only interesting, but also vitally important).

I do not, of course, wish to imply that a great deal of discretion should not be left to individual teachers in the selection and presentation of their lessons. I personally do not favour a highly centralised bureaucratic teaching system. However, this Conference is taking place because many experts throughout the

world believe that the degradation of the environment has reached a crisis level. And in a crisis it must be foolhardy in the extreme to leave to mere chance the likelihood of our young people receiving the education which will enable them to understand and deal with manifestations of that crisis, in whatever field they may find themselves as adults, or simply as members of a community.

With the present world-wide awareness of environmental deterioration, there are some signs of a growing movement towards positive action. For example, last year saw the establishment of the Australian Science Education Project, in which all States and the Commonwealth are participating. This Project will provide learning materials suitable for use by students, and guidance for teachers in Science courses for the first four grades of secondary school. In January this year, a conference was held in Melbourne to discuss guide-lines for the Project, and it was decided that a strong emphasis should be placed on environmental problems. A statement from the Chairman of the Project, Mr H.O. Howard, included the following: "We believe that science now has a unique obligation to mankind arising from the fact that it is the basis of technology, and is therefore responsible for having provided the opportunities for the generation of social issues such as pollution and the road toll. Science education must, on behalf of science, accept an obligation to make its contribution towards resolving such issues". It will be five years before the work of the Project becomes available to schools. Many teachers with whom I have been in contact have mentioned the need for teaching aids related to environmental education and have pointed out that they find it difficult to obtain resource material, which is not available to them as readily as that related to topics which have a firm place in established syllabuses.

In the meantime, while most of our schools and teachers' colleges do not specifically devote time to co-ordinated studies of man in society from an ecological point of view, it is in fact being left to the mass media to perform the major role in environmental education, not only for the adult population but also for the school children and, moreover, for the teachers by whose individual discretion environmental education in the schools is mainly provided at present. After reviewing the present situation, my personal opinion is that there is an urgent need for our educational authorities to assume a more positive role in relation to the environmental crisis. Even if parts of our traditional syllabuses have to be discarded, provision should be made now to include environmental education in both schools and teachers' colleges. The present incidental, unco-ordinated and haphazard treatment is totally inadequate.

Young people should be leaving school with an understanding of the environmental crisis in scientific and social terms; and, furthermore, with a positive sense of responsibility towards the solution of these man-made problems which they will have to face as adults in the last part of this century. Many of today's youth are in fact reacting against the values of a society which they find very

unsatisfactory. They are spurning the materialistic equation of "progress" with technological expansion. Their dissatisfaction, however, all too often rests on ignorance, and their reaction is of the "stop the world – I want to get off" variety. Surely, our schools should be providing the intellectual and ethical stimulus necessary to channel this dissatisfaction into purposeful directions, and none can be more important or more urgent than that of actively promoting the restoration and preservation of the quality of our total human environment.

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COMMENTS

David G. Morgan*

In introducing discussion of the issues raised so far, and of some yet to be raised, it may be helpful to make some observations from the viewpoint of an educator, of someone who has to make decisions about the types of classroom programme undertaken by students.

Amongst educators, I of course include governments, the mass media, parents, and the people next door, as well as those running our formal educational institutions. However, at the moment I will restrict comment to that part of education for which schools are responsible. In our society, the schools are possibly the only social influence common to all; if every citizen is to be reached, then the school is the easiest place to reach him.

If this Conference is to have a reasonable chance of success, it is important that we be realistic; to be realistic, there are several points that should be made about the school system.

Firstly, the individual teacher is a key person. You would misunderstand the classroom situation if you believe that understandings and attitudes are developed in students by the decisions of some all-wise educational administrators who decree what is to be done. It is certainly true that the nature of a classroom programme is strongly influenced by externally-imposed syllabuses and courses of study, especially in situations where students are to sit for external examination. Such examinations, however, survive today only towards the end of schooling and, in some places, may disappear altogether within the next decade.

Unless the goal of a classroom programme is simply the presentation of information to be remembered for a knowledge-orientated external examination, what is achieved in the classroom varies widely, and depends on the teacher. It is the individual teacher who is master in his own house, who decides what should and should not be included in courses he conducts, who decides what learning situations are provided in his classroom and who determines how effective his programme is. What happens in the classroom is determined by the understandings and attitudes of the teacher; even if there is an externally-imposed syllabus and an external examination, the teacher remains the intermediary between these and the student.

If first-rate resource materials are available for a course the teacher is following, he may follow these fairly closely. But he is not obliged to; nor, in many situations, does he feel obliged to follow a set course of study if he decides it is not in the best interests of his students. Educational authorities in some States now recognize this and, as Mrs O'Neill puts it, leave things "to the discretion of teachers".

It may be worth remarking in this context that some teachers believe that it is somehow meritorious to avoid following a set course: to follow any alternative procedure shows that the teacher is a true professional who knows much better than "the experts" what is best for his own students. Prescribing a detailed syllabus to such a teacher does not ensure that it will be tackled convincingly, if at all. Prescribing environmental education in courses of study cannot guarantee impact on students.

Secondly, the teacher sees a variety of tasks which he must accomplish in the classroom, in a limited time. A youngster must be given certain basic skills needed for life in our society, so that he can make his own way. Sufficient of the accumulated culture of mankind must be passed on to him for him to become informed about the rest of mankind and about the non-human world as presently understood by man. (This latter area can be regarded as the field of the pure sciences and must include, of course, the impacts of man on his environments. That this area is part of our present culture argues for its inclusion in educational programmes for the sake of comprehensiveness alone, if not for other reasons as well.)

A youngster must be trained in intellectual skills so that he can think for himself in an objective, ordered way. He needs to be so educated that he becomes interested in the world

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about him, requires evidence before making judgements, knows how to obtain evidence, can weigh such evidence, and reach the conclusions best warranted by the evidence available to him.

Most educators would agree that, in our society, the principal function of the educational system is to produce independently-thinking individuals, people capable, not only of making their way in society, but of contributing to it as well. This is different from the idea pervading some societies that individuals should develop the skills, understandings, and attitudes deemed by those in authority to be in the best interests of the society and State in which they live. I suggest, then, that in our society, it would be seen as improper for a teacher to set out to develop a particular attitude in his students to a particular social question.

Most people who have become concerned about man's effects on his environments believe that something should be done about it, which means producing particular attitudes in people. Some believe that the schools should be producing a generation of people anxious to do something about the "environmental crisis". Few educators would agree that they should indoctrinate students with attitudes that they personally see as important; it is too easy to develop an attitude which has other than a rational basis.

Attitudes can result from our personal experiences, however inadequate or atypical. They frequently develop as a result of perceived social pressures, particularly in areas in which people feel insecure; many attitudes are acquired from people we admire or from groups to which we attach ourselves. Youngsters at school level are particularly susceptible to acquiring attitudes from people they respect, including some of their teachers. A responsible teacher sometimes has to bend over backwards to ensure that his own attitudes and prejudices do not obtrude in the classroom situation, that he indeed produces students who can and do make up their own minds on issues. The thoughtful teacher sees his task in this area as educating students to face issues, examine all sides of them, discuss them with others logically and objectively, and to reach conclusions – and attitudes – warranted by the evidence available. The student should also be able and willing to change his attitudes in the light of new evidence.

To learn to do these things, a youngster does not have to face every social issue of the day in the classroom. Different teachers will argue that drugs, poverty, war, racism, censorship, teachers' salaries and working conditions, even environmental questions, are each of such overriding importance that they warrant time in the classroom, and time is limited.

Further, we cannot know all the vital social issues of 1980, 1990, or 2000, so that they can be dealt with in class and an "appropriate attitude" developed towards them. The educators' task must be to produce citizens who are ready and capable of tackling all social issues responsibly and capably – as citizens – wherever and whenever they occur.

If a teacher is given opportunity to develop attitudes towards particular social issues, he will treat only those which seem important to him, and may not act in the best interests of his students or his community. As things stand at present, only a proportion of teachers would devote class time to environmental questions. And the attitudes that their students develop, if any, may not be contributing to solutions to such problems in the long run.

I believe that it is far more important that we encourage the development of thinking, responsible citizens through classroom programmes directed towards these goals than attempt to decree the teaching of particular information and attitudes.

Information on man's effects on his surroundings merits inclusion in school programmes simply because it is part of man's culture. To have such information included in school programmes, all that has to be done is to convince educators of this, then provide the necessary information for them to use!

If the teacher is to see a need for environmental education in his classroom, his own attitudes have to be changed. Since there are tens of thousands of teachers, changing the attitudes of each presents real problems. What we know already about attitude development suggests that teachers could become convinced of the need for environmental education if the following procedures were adopted:

1. Involve the teacher personally in study of man's relationships with his surroundings, perhaps through in-service courses. This would provide the 'meaningful environmental encounters' discussed by Professor Stapp.
2. Create a social pressure for solutions to environmental problems so that the individual teacher, wherever he is, is reached and affected by such pressures.
3. Argue a convincing case, backed by appropriate evidence, through media which reach the teacher whose concern has been awakened.

4. Let the teacher realize that he is capable of making a positive contribution to the solution of environmental problems.

Without a concerted effort to reach the teacher, a majority of school students will neither be aware of, interested in, nor able to face environmental issues. Once the teacher has been reached, he will see a need for resource materials to be used in developing socially-aware, thinking, responsible students. It is up to those with expertise in environmental studies to develop community awareness, then to see that suitable materials are available to the teacher when that time comes.

Margaret M. Robinson*

As Mrs O'Neill has pointed out, the number of people at this Conferenceofficially representing educational policy makers at the school level is disappointingly small.

Could, perhaps, part of the reason be that notification about the conference aroused a suspicion that the outcome may be an appeal from yet another pressure group urging the inclusion of yet another course of study in the already over-loaded school curriculum?

Over recent weeks, reports have appeared in newspapers in which various groups have pressed for the inclusion in school curricula of such diverse subjects as road safety and driver education, use of hire purchase and building societies, elements of law, psychology, sociology, interpersonal relationships and so on. The question arises, how can all this possibly be fitted into the school day? After all, with everyone else's leisure time increasing, school students are unlikely to take kindly to an increase in the hours they are expected to work. Perhaps in the face of all this, the standard Departmental reaction has become to turn a deaf ear.

The phenomenon of these demands may in itself be fair comment on the fact that much of what is taught in schools to-day is unrelated to the world in which pupils are expected to survive and make a living on leaving school. However, this raises other issues which could form the basis of many future conferences. The Wyndham Report states that "there are certain fields of thought and experience of which no adolescent should be ignorant as a person or as a citizen, irrespective of his ability and of the situation in life in which he may later find himself". It then goes on to suggest that this may be achieved through a group of core subjects, English, Social Studies, Mathematics and Science, Music, Art, Craft, Physical and Health Education and Religious Instruction.

Syllabuses in each of these subjects have consequently been produced by separate committees with little or no attempt to search for bridging ideas which would serve to bind the various syllabuses together into a coherent whole. Thus, a frequently heard criticism of secondary education is that it is fragmented by its separation into strict subject areas.

To illustrate just how 'compartmentalised' student thinking can be, I would like to relate an incident told to me recently by a teacher of Senior Chemistry. The class was discussing polar molecules and it was pointed out that DDT was not particularly polar. Some problems were then set in which students were asked to comment on the relationship between the oil solubility of DDT and its transmission through the insect cuticle and through food chains. This caused something of a minor uproar in the class, the students basing their objections on the grounds that the questions involved biology and, after all, this was supposed to be a chemistry course. And this came after four years of what was supposed to be "integrated science" in forms 1 to 4!

The point I would like to make here and to which Professor Stapp has given emphasis, is that environmental education could be used within the present curriculum structure as a *theme*, cutting across the subject boundaries and integrating the whole of education.

To illustrate this, I would like to suggest that History, Social Studies and Economics could be used to examine the effect man has had on the biosphere from prehistory, through the Neolithic, Agricultural and Industrial Revolutions, to the present day, and the biological,

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social and economic consequences of these; Geography, Science and Agriculture lend themselves to discussion of soil, water and air pollution, chemicalisation of the environment, conservation and the utilization of natural resources, and other problems of urbanisation and technology; Home Economics could be used to make future housewives aware of the consequences that their activities within the home have for the environment and vice versa. Detergents and chemicalisation of foodstuffs are two examples which come to mind. Why not use the English class "to study some of the mounting literature concerned with threats to the biosphere" which Mrs O'Neill has included in her definition of environmental education?

I hope this has served to illustrate that the urgent need for environmental education could be fulfilled without the inclusion of yet another subject in the school curriculum, but rather that it be used in the spirit of the pure core curriculum in which emphasis is placed on a core of social problems and functions which can be used to integrate the various subject areas. Implications for teacher education are immediately evident, namely that environmental studies would become a part of teacher training for *all*, and not merely for future Geography and Science teachers.

Dr Boyden quoted the historian Lynn White, Jnr. as doubting "that this disastrous ecological backlash can be avoided simply by applying more science and technology". Both Dr Boyden and Mrs O'Neill have referred to the attitude to science as a panacea for all man's problems that is engendered by many current Science textbooks. Thoughtful students, I believe, have already begun to sense a note of dishonesty in these attitudes and perhaps herein lies, at least in part, the reason for the reported drift from the sciences in recent years.

Their awareness of problems relating to man's interaction with the biosphere derives from the mass media or from contact with teachers who have felt sufficiently strongly about the problems to devote some time to their discussion.

When this awareness is aroused, many students react indignantly to what has been allowed to happen and, with the vitality of youth, are prepared to commit themselves to doing something about it. However, as educators, we must have something to offer. We must be able to point out possible lines of action or areas in which solutions may be sought. Simply leaving students with the problems may further add to their disenchantment with the older generation and increase the number of converts to the "I want to get off" philosophy to which Mrs O'Neill referred.

May I then urge that this Conference gives due consideration to ways and means by which an understanding of human ecology may be incorporated into the overall aims of education in our schools, and into the preparation of those who will teach in them.

L.J. Webb*

I have been wondering whether the young are as badly in need of formal education about the environmental crisis as we suppose. I wonder whether or not many young people, in their crazily telescoped generation, may not have a finer understanding, a clearer intuition if you like, about the status, responsibility and future of mankind than many of us who, while preaching the "total view" and the "unity of environment", continue to act as though life is meaningful in little disconnected bits, as though education can be sawn off from legislation and politics and so on.

I was glad, therefore, that Professor Stapp put in a "plug" for youth by suggesting that it should be represented on committees, and noting that it expects effective action and not just talk.

Is the dissatisfaction of youth – "stop the world, I want to get off" philosophy remarked by Mrs O'Neill – any more than a normal and healthy reaction to the accelerated speed of social rather than biological evolution? As Alex Comfort points out, this is a problem in the "technology of the emotions", and so part of the environmental crisis.

There are today, as Dr Boyden ruefully admits, two camps: the optimists and the

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pessimists. I must ask whether it is entirely fair, or even useful, to denounce science and to deny the reasonable possibility that science will continue to provide enlightenment and prosperity as it has done in the past. Not all biologists are pessimists, and Peter Medawar is a notable exception. Admittedly, as quoted in Mrs O'Neill's paper, "science now has a unique obligation to mankind ... for having provided the opportunities for the generation of social issues such as pollution and the road toll". Taking "opportunities" at their face value, are we prepared to question more deeply (however dangerous these thoughts may be) the validity, in humanist terms, of the social and political pressures – what Dr Boyden calls "various vested interests" – which overtly or otherwise dictate the way which scientific knowledge is used or misused?

I sense some contradiction between Professor Stapp's and Dr Boyden's attitudes to the relevance of technological solutions for the environmental crisis. No one has yet identified the area beyond which technology is bound to fail, and this boundary – this totally unexplored ecotone – can never be static.

I continue to wonder whether it is not an over-simplification to suggest, as Dr Boyden does, that the root of our environmental crisis is the accelerating "interaction between the ancient processes of nature on the one hand and the new forces of culture on the other". Am I wrong in detecting mechanistic overtones in this statement? When man interacts with and transforms nature, he also transforms himself: there is a continuing feedback which modifies cultures, generates new values and fabricates new moralities. Man, we may remember with Kesteven, is not just a termite, and, as human beings, we demand more than what Koestler calls the "ratomorphic view of man".

And if science is to be challenged, why not art? Is art failing to provide man with a 'life substitute', so that he may retain his equilibrium with his environment – isn't it relevant to our environmental problem that the artist desires a world "which makes sense", desires self-fulfilment, liberation?

We find ourselves in an age when we have "knowledge of knowlege itself" (as Bernal put it) – the knowledge that if we don't know the answers, we do know how to find them out. Isn't the root of our environmental crisis, then, rather more than the product of an interaction between culture and nature? Doesn't our modern position involve a new responsibility, to know and to act according to the best of our knowledge? Isn't it fundamentally a problem of choice – at least in the developed countries – where, as U Thant says, "it is no longer resources that limit decisions; it is the decision that makes the resources".

It is interesting, therefore, to read Professor Stapp's definition of the goal of environmental education – to produce a knowledgeable citizenry that is aware of how to solve environmental problems and is motivated to work towards their solution.

As an ecologist, I have no hesitation in saying that we cannot avoid ethics, whatever our definition – the greatest good for the greatest number, long-range rather than short-range benefit, enlightened self-interest, reverence for life, or just Goethe's interest in what things are and mean, rather than what they do. Anybody who is concerned about the environmental crisis, with the care of the human habitat, is immediately involved in value judgments; e.g. ecologists when they refer to soil fertility and soil stability, let alone the quality of life. Yet reference to values is still, in some quarters, regarded as an unsound and suspect procedure for a scientist.

I am an optimist in that I cannot believe that we are at the mercy of an "autonomous set of processes over which we seem to have little if any control" (Boyden). Doesn't science try to predict, understand and so control processes? Is our science so helpless? And why blame science as such? For example, we are confronted with the evolution of bigger and better species of bulldozers. Is bulldozer-speciation an autonomous process? We must surely ask: why are bulldozers made, and *who decides* which forest or coastal sand-dune or mallee scrub they will flatten?

If tertiary institutions are failing to give a "comprehensive and balanced view of life", I want to know *who stands behind* the deficiencies. Why do universities continue to produce (say) agriculturists who are dedicated to throwing a blanket of pastures over millions of acres of northern Australia, irrespective of inherent ecological differences in the terrain, in the holy name of land development? Or foresters who are "hooked" on wood-harvesting, either by felling the tree or making a hamburger out of it, as with wood-chips, foresters who think that

wildlife preservation is for the cranks if not the self-starters?

The reason behind the activities of tertiary institutions in these fields seems obvious enough: the drive for increased production, development, economic expansion, progress. All holy words. Mr Lang Hancock, the West Australian millionaire-miner, expresses this drive succinctly:

> "I have never given a thought to conservation or pollution in any project I have undertaken. All I am interested in is getting the ore out as quickly as possible and selling it. There is no limit to the amount of ore in this State, and we have to turn it into cash. If there is any mess left, somebody can clear it up afterwards . . ." (Australian 22.4.70).

Mr Hancock is obviously one of the men we are looking for, the men who make the decisions. Let us see what happens when we put Aldo Leopold alongside such a man.

> "That land is a community is a basic concept of ecology, but that land is to be loved and respected is an extension of ethics. That land yields a cultural harvest is a fact long known . . . The 'key-log' which must be moved to release the evolutionary process for an ethic is simply this: *quit thinking about decent land-use as solely an economic problem* . . ."

How does the educator in the environmental crisis handle this situation? I suggest that here is one root of the double standards rampant in our society: our teacher may be obliged to explain to the kids that if you cut down a shady tree at the corner of the street, you are a vandal; but if you clear thousands of brigalow scrub and leave not a wrack behind you are a pioneer to be respected.

What I am trying to suggest is that education about the environmental crisis – if I am to believe its urgency as so eloquently described at this Conference – cannot and may not dodge the very real social and political issues which the young see as the decor behind the shadow-sparring of their elders in the conservation establishment.

Let us be clear what conservation means and involves. It has three aspects: technical, administrative and political. These aspects overlap and flow into others such as ethics and legislation. Where are our "hard data" in ecology? Discussions at this Conference reveal the many gaps in our technical knowledge, whether of systematic measurements of ozone in the atmosphere over Sydney or of the absence of an account of Australian vegetation. Who will foster the collection of such data? "Who will pay?", as Professor Stapp likes to ask.

As for the administrative aspect, the tangled skein of State and Federal relations must repel the stauchest of hearts. Finally, the political aspect: I need only ask the conundrum which is going the rounds in conservation circles: should Governments lead the people, or should the people lead the Governments? Government spoksmen blame the people for not prodding; and, when the people do prod they are branded as bleeding-hearts and agitators.

Clearly we need a drastic change in our social attitudes. Is this possible simply by education of the young? By the time they grow old enough to join the decision-makers, it may be too late – that is if they succeed in retaining their idealism in a world of double standards.

ENVIRONMENTAL EDUCATION IN BIOLOGY FOR NON–BIOLOGISTS AT THE TERTIARY LEVEL. By Jan Mercer*

There is increasing awareness among the Australian public of the environmental crisis which faces the world. This has been stimulated through the media of the press and television. This activity, however, good as its aims and achievements may be, is not sufficient if concerted action is to be taken to solve the problems that have arisen and which will continue to arise in the future as world population inevitably increases. We need to educate our future citizens more fundamentally on the nature and extent of our environment. This must include a knowledge of ourselves as human beings if we are to understand the impact we have on the environment and how the environment affects us.

Tertiary Education on the Environment

Outside Australia, widespread concern has been evinced by people in all walks of life concerning this problem, but particularly by scientists and especially by biologists. The study of the living world is their business and the effects of human activity on its condition are most immediately noticeable to them. Several biologists in the U.S.A. have stepped into the public arena in an attempt to draw the serious concern of politicians and laymen to the problem. I am thinking here of such men as Professors Garrett Hardin, Barry Commoner and Paul Ehrlich. Attempts are certainly being made to educate our adults, but frankly I think we have a much greater chance of making real progress with the young. Part of the responsibility for educating future Australian citizens must devolve on those of us who are teaching in the universities. I believe that it is our job to see that all our graduates in any discipline are well-informed citizens and are armed to face the enormous challenges with every weapon we can give them. To quote Lynton Caldwell of Indiana University (1969): "Nowhere is the need for action greater than in the colleges and universities and especially during the undergraduate years. It is at this stage in the development of intellect and personality that the direction of future leadership appears."

In respect to this, it is pleasing to find that a number of attempts to introduce programmes on environmental education are being made in many universities and colleges in the United States. At the end of last year, the American Association for the Advancement of Science held a symposium in Boston on "Undergraduate

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Studies in Environmental Science". Although I have only a preliminary report on the papers given at this symposium, it is clear from this report that most of the approaches to the problem of education in the environment at this level are at least broadly based on biology and particularly on aspects of ecology. These programmes are already in operation at such institutions as Stanford University, the University of Pennsylvania and Boston University. Cornell University attacks the problem on a broader front and runs an inter-disciplinary programme to which staff contribute from all the principal disciplines including the social sciences, the humanities and the natural sciences. The titles of two new courses to be presented at Cornell this year are "Biology and Society" and "The Social Implications of Technology". I could cite many further examples. It would seem that most major universities in the U.S.A. and many of the colleges are already facing the challenge of presenting environmental education to their students. Apart from the United States, universities in Europe are also attempting the task. At the University of Lund, Sweden, an environment research programme has been developed, largely as the result of the interest of graduate students. This includes a course on pollution and natural resource planning and involves the co-operation of the university, industry and others interested in the problem.

"Man in the World of Life" – the programme presented at Macquarie University

This is a biology course which is designed for presentation to non-biology majors.

It is an attempt to give a course in biology with especial emphasis on its relevance to understanding our environment. First, I would like to speak of the detailed aims of this course and how we try to achieve those aims. Then I would like to discuss some of the problems which have arisen out of conducting such a course, both for the present and in the future.

When I joined the staff at Macquarie, I was asked to prepare a biology course for non-biology majors – this was the original broad requirement. In early discussions on the nature and content of the course, it fairly rapidly emerged that this could be slanted very differently from the kind of course which biology majors would be expected to take as a preliminary to their professional training. Many considerations which are necessary in the training of a professional biologist could be left aside here. It seemed to me that, in this case, biology could be used, to quote the Director of the Commission on Undergraduate Education in the Biological Sciences (M.W. Schein, 1967), "with the intention of preparing students for intelligent functioning as participants in a contemporary world". In a short (half-year) course we could afford to eliminate some material normally given to first year majors and include some subject-matter not dealt with until later years in the latter case. The object became one of introducing certain fundamental concepts

and using these to explain the relevance of biological knowledge to our understanding of the impact we have on the world and the impact the world has on us.

I was confronted with a number of decisions to be made at the outset. The background and interests of the students were of prime importance. I had to assume that a high proportion of the group would not only be non-biology majors but also non-science oriented. This turned out to be the case – about 50 per cent of the students having science subjects as their main interest, the rest coming from the whole academic spectrum. This question of teaching science to non-science students has been a matter for much discussion in the U.S.A. and Britain over the last few years. There seem to be two reasons for this re-evaluation – the first being a general decline in interest in science and the second being an upsurge in criticism of teaching methods, which has perhaps partly arisen out of the first reason. One of the initial problems confronting anyone who wishes to give students in general some background and understanding of environmental science from the biological viewpoint is also one which confronts anyone given the task of presenting a science course to non-science students. In the United States, a recent attempt in the direction of teaching science to non-science students was embodied in the Harvard Case Histories in Experimental Science (1966). In his Introduction, James Conant states:

> "The Harvard Case Histories in Experimental Science were designed primarily for students majoring in the humanities and the social sciences. Such students require an understanding of science that will help them to relate developments in the natural sciences to those in the other fields of human activity. To do so demands an understanding both of the methods of experimental science and of the growth of scientific research as an organized activity of society. Experience shows that a man who has been a successful investigator in any field of experimental science approaches a problem in pure or applied science, even in an area in which he is quite ignorant, with a special point of view. One may designate this point of view 'understanding science'; it is independent of a knowledge of the scientific facts or techniques in the new area. Even a highly educated and intelligent citizen without research experience will almost always fail to grasp the essentials in a discussion that takes place among scientists concerned with a projected inquiry. This will be so not because of the layman's lack of scientific knowledge or his failure to comprehend the technical jargon of the scientist; it will be to a large degree because of his fundamental ignorance of what science can or cannot accomplish, and his subsequent bewilderment in the course of a discussion outlining a plan for a future investigation. He has no 'feel' for what we may call 'the tactics and strategy of science'."

It is my belief that in presenting any science course it is essential that students be given a "feel" for "the tactics and strategy of science", otherwise much of the value of such a course is negated. Therefore, one of the major aims in presenting this course was to give the participants an understanding of science. From this and other considerations, production of a course of this type becomes a matter for very careful planning and preparation. Initially, decisions had to be taken on such matters as lectures – how many if any? Should there be associated laboratory classes – if so, of what kind? Should tutorial sessions be run and how

should these be organized? Then there were other questions to be considered – assignments, textbooks and reading lists.

Since, under the circumstances, one of the most important objectives in teaching this course was to stimulate the enthusiasm of the students in a subject that was not their first choice of interest, I decided to use every possible teaching device for this purpose. The lectures would be used to give a background to the material chosen for study, to integrate the various aspects and most of all to excite the interest of the students. I was very fortunate in the panel of lecturers who were prepared to do this job. Each is an expert in his field and each has the ability to present material in such a way that students with little training in science can understand and enjoy the lectures. I am aware that there is a trend away from formal lectures – possibly because students tend to find them boring, which must mean that they lose their value as teaching devices, and also because, all too often, lectures become repetitions of textbook material rather than expansions on text themes. Probably because our lecturers are so good, this has not happened in this course. I also believe that using a panel, rather than one lecturer, has a psychological advantage. Each is a very definite personality who, if I may use the term, "projects" well. Certainly the reception has been excellent and we have had comments of approval given spontaneously by the students.

The second question, whether to hold laboratory classes or not, was a little more difficult to answer. There was the possibility that the non-science students would not respond well to the set times demanded by lack of laboratory space and time-table difficulties, and that the extent of time to be spent in the laboratory would be a deterrent. On the other hand, I felt that seeing and handling living plants and animals helps immeasurably, not only to stimulate interest in biology as such, but also to create awareness of the living world outside the laboratory. Also, as I stated earlier, I feel it essential to convey some of the feelings and aims of experimental work in biology or, for that matter, in science. Lastly, the laboratory seemed to me to be an excellent venue in which to present attractive illustrative material which could be used to stimulate interest in the subject by visual means.

Tutorial-seminars are also included as part of the course. Since these require preparation on the part of the students and their work load is fairly heavy in most cases, these are only held every second week. We have tried to pick topical and controversial subjects which the students would enjoy discussing and which allow for the interpretation of biology as a study highly relevant to modern life. Apart from these aspects of tutorials, they allow students to get to know each other and the staff on a very informal level. As much as possible, we like the students to dominate the discussion. This is sometimes very difficult for them because it is so hard to find relevant topics not requiring considerable background.

So much, then, for the time-planning side of the course. The next problem was the choice of subject-matter. Time was limited – the course was to run for a

half-year, i.e. 13 weeks. As has been remarked by many people running biology courses, no two biologists will choose the same material. It would almost certainly be an impossibility to include every aspect which a group of biologists would consider necessary in a course of this kind. Certain areas, however, would seem to be essential in any elementary course setting out to achieve the aims I have mentioned: energy flow through the community, the basic unit of living matter – the cell, DNA and the elements of genetics, the interrelations of plants and animals and the complexities of any natural community, and the finite nature of natural resources. The problem was to weld these fields into a coherent story relating man to his position in the world of life. In the initial lecture, I acquaint students with the aims of the course and stress the need for an understanding of fundamentals as a basis for criteria in dealing with such topics as pollution, food and population problems, the interactions of organisms and the effect man has on his environment by his very existence, let alone his modern activities. At this stage, we also mention the "two cultures" hypothesis and discuss the need for everyone to understand some basic science if they are to make an intelligent approach to living in a world so largely governed by scientific and technological advances. This matter is mentioned in lectures and expanded in a tutorial session – which I found to be one of the most rewarding and lively tutorials held. Having so introduced the course, I pass on to the topic of energy flow, from the sun through plants and animals and microorganisms, presenting the earth as a very rare unit of limited resources, nearly all life forms being dependent on an external source of energy. Some discussion on heat exchange and climate is included here. Photosynthesis and respiration are used to explain the basis of energy flow through organisms, but detailed biochemistry is omitted. Concurrently with these lectures, we run classes to illustrate the diversity of plants and their interdependence. Food sources and feeding mechanisms are emphasised and, as far as possible, food pyramids are constructed for both an aquatic and a land environment. A great deal of living material is used here – marine and rock platform plants and animals, lizards, frogs, snakes, birds, wallabies and monkeys. We also use a great deal of illustrative material, e.g. charts and photographs, to make the class-rooms attractive and interesting to the students. This material is certainly used partly for effect, but we use it a great deal in teaching, too, and find this type of visual instruction very useful. These first two laboratory classes have another purpose; they introduce students to what I call the natural history aspect of biology. In teaching the current type of first year courses in biology, which are often of a functional and quantitative kind, I have found that many students, both majors and non-majors in the subject, were disappointed at the lack of this type of material. Some complained to me that they did not see plants and animals in any variety and "that is what I thought biology was all about!" From these comments, I judged that it was sensible to introduce as many live animals and plants as I could wherever this

was feasible.

The cell as the basic unit of living things is taken as the next theme in both laboratory and lectures. In illustrations here, we develop the history of the cell theory and the importance of technological advances such as the electron microscope in reaching our present understanding of the structure and function of cells.

With energy flow and the cell as an introduction, we pass on to consider man himself. The next part of the course is concerned with some basic human anatomy and physiology which is taught in a series of lectures and laboratories. The approach is simple – to show the working of the human body – for instance, the relation between bones and muscles in movement, and the control of the body through the nervous and endocrine gland systems. The blood vascular system is explained and such matters as blood pressure, cardiac rate and output, the structure and function of blood and blood groups and how these are determined, are discussed. One lecture is devoted to the menstrual cycle and the associated hormones and the functioning of birth control pills in contraception. We run a seminar on venereal diseases and another on drugs and drug addiction concurrently with this section.

Next, we turn to the subject of heredity – there has been much discussion on whether DNA-RNA should be included in a course of this kind. Some biologists maintain that the students generally taking such courses have insufficient background in chemistry to understand molecular biology.

Since DNA is now a term in fairly common usage and is so important in understanding cell metabolism and genetic change, I would feel positively guilty about omitting it from a course in which we aim to educate students about the world at this time. We find that most of our students do grasp the essentials without too much difficulty, regardless of their lack of chemistry. Dr Robinson, who lectures in this part of the course, presents the DNA theory from an historical point of view with Watson's "The Double Helix" as recommended reading. This is not only a fascinating story in itself, but shows the student a little bit about how science is done. In practical classes, the DNA-RNA theory is reinforced by the students constructing nucleotide sequences from coloured pegs and wires. The students also code amino acid sequences. We usually have pretty vigorous discussion on hereditary defects and aspects of racism in these classes. The future possibility of man's manipulation of the hereditary material along the lines of Rattray Taylor's "Biological Time Bomb" is also introduced in lectures, as well as certain aspects of practical genetics – plant and animal breeding. In this way, students are made aware of the achievements in agriculture in the past, and how further work in plant and animal breeding may help to increase the world food yield. The often terrifying prospects of the future with regard to human genetic manipulation is something we feel should be stressed, since many of the audience

could later be concerned in the decisions which may have to be made in this regard.

This segment of the course completes our study of man himself. We then turn to a consideration of a group of other living things – the microorganisms. I chose this group for two reasons. Firstly, because they are found in almost every environment on earth and show such a wide range of nutritional adaptations, which makes them an interesting group in their own right. Secondly, because microorganisms exert an influence on every facet of life in all its forms. The importance of microbes in agriculture is emphasised and the students are introduced to the microbiological aspects of the canning and frozen food industries, as well as to the importance of microbes in medicine. "Famine on the Wind" by Carefoot and Sprott is recommended reading for this part of the course and Postgate's "Microbes and Man" is the set text. Last year we ran a tutorial on the economic and historical importance of various plant and animal diseases, including the Black Death.

In the laboratory, the students see some of the techniques used in microbiological studies and themselves carry out some simple experiments, including the inoculation of various media and a study of the growth of *Escherichia coli* under optimum conditions. This latter experiment gives them a realistic idea of the rapidity with which bacteria can multiply, something which is difficult to convey when treated only theoretically. Some attention is also paid to the uses of antibiotics, the history of their discovery, and their function and industrial production.

Having introduced students to a group of microscopic organisms and their wide-ranging effects on other organisms, we now take up the problem of interaction on a broader basis – the ecology of natural plant and animal communities. A consideration of man's effect on the natural environment follows, starting with a description of primitive man, the evolution of social behaviour and the development of culture. Next, the effect of modern man on individual environmental components is discussed, including the effects of man's activities on air, water and land resources, vegetation and animals. The value of natural scenery as an important aesthetic factor in modern life is stressed. Finally, the extent and availability of resources is presented in conjunction with considerations of human population growth. We hold a tutorial on population problems and the world food crisis, recommending as background reading such books as Paul Ehrlich's "The Population Bomb" and the series of articles presented in the May, 1968 Science Journal.

For practical work in this section, we take the students on a field trip along the Lane Cove River where they can study at first hand the effect of man on two types of natural community – an estuarine mangrove flat and a bush community. Few, if any, of the students have previously been aware of the value of a mangrove community as a resource and have been ignorant of its biological

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importance as a source of organic food for fish and crustaceans. The way in which reserve lands may be developed for recreation, and for the aesthetic satisfaction they provide, is discussed during this trip, together with considerations of the conservation of plant and animal life in an urban area. We discuss the problem of the dumping of solid and fluid industrial wastes and of domestic wastes. One practical class is devoted to the analysis of river water for pollutants, the students carrying out the tests themselves – often with weird results! – but this is a valuable exercise. At the conclusion, they make out short reports in which they are asked to give opinions on constructive steps which might be taken to conserve wildlife and natural beauty and to say how they would go about the control of pollution in an urban environment. Plenty of ideas are forthcoming in these reports and most students are realistic in recognising the need for large amounts of money to be spent in solving these problems.

To round off our course, we have several lectures on aspects of animal behaviour, having in mind that an understanding of behaviour may lead, hopefully, to its control. The students were so enthusiastic about these lectures last year that I am expanding this part of the work while cutting down where we feel it sensible to do so on other aspects of the work.

The theory of evolution is not dealt with as a major topic. We do not omit it however. Last year an assignment was set on Darwin and his ideas which should have given students a good background to the theory. Added to this we use illustrations and charts in various laboratories to reinforce the general ideas of evolution. There is an inherent treatment of the subject without major emphasis in the way of lectures or set laboratory classes.

At the end of the course, we ask the students to fill out a questionnaire. The purpose of this is to gain a more detailed knowledge of the academic background in science of the students and to assess previous reactions to the subject. We also want to know how they respond to this course *in toto* and to its various aspects.

Generally speaking, reactions were enthusiastic, which was very satisfying to us. Six per cent stated that they did not enjoy the course; either they were disappointed in it or felt they had not benefited from it in any way. (It is interesting to note that these individuals were economists). We were particularly interested in the response to laboratory and tutorial work. There were also some obvious drawbacks which we anticipated might affect student reactions. For example, as a result of time-table difficulties, it was necessary to hold tutorials and laboratory classes in one time block, which meant 3½-4 hours continuous work in the weeks when tutorials were held. In fact, 45 per cent of the students indicated that they found this too long a period. I feel that this is a significant number and am intending in future to reduce the length of the practicals on days when tutorials are to be held. The tutorials were reasonably well received although many students (50 per cent) wanted more controversial topics. We were also interested to find out

whether or not the level of the course was generally found to be too advanced for the science background of the students. Twenty-five per cent indicated that they were hampered by a lack of previous training in biology and that too much prior knowledge was required in the course. We assume that all of our students have completed the first four years of High School Science, but this does not seem to be sufficient in terms of what is really learnt and retained from school.

I would like to summarise the aims and intentions of our course, which I believe to be necessary in any course of this kind, regardless of curriculum content.

1. To give students a feel for the tactics and strategy of science.
2. To show the applications of biology to the contemporary world.
3. To place man in perspective with regard to his role in the living and non-living worlds.
4. To give students sufficient information on the topics discussed to provide them with a critical basis for the evaluation of proposed solutions to environmental problems.

In conclusion, I would like to mention a few of the problems that have arisen in teaching this course and some of those which will confront us in the future.

The first of these concerns staffing. Who is going to be prepared to teach such courses? In this age, most academics are trained in specialised branches of their subjects, so that few feel competent to teach an entire course of this kind. Also, there are some disadvantages about teaching such a course, especially as a long term proposition. Most students do not stay in the department; and the teaching and administrative demands on anyone teaching such a course are so great that there is little time left for teaching advanced courses in one's own speciality, or for personal research. In our academic system, as elsewhere, much of one's advancement in scientific fields, both in teaching and scholarship, is dependent on achievements in these two latter areas. There is also, I must admit, some indication that colleagues are inclined to derogate those who spend much of their time in this form of teaching. This, I may say, applies to first year professional teaching as well as to teaching a course of the kind I have outlined here.

Secondly, a more serious problem – this course as we teach it simply does not, in my opinion, go far enough. We spend a considerable proportion of our time teaching basic biological material which should be part of a student's equipment before he reaches the university. I believe that an understanding of how science works and at least a preliminary grasp of the nature of the environment should already be part of that equipment. We do not find this to be true in the majority of cases. I would hope that, within the next few years, we may see a substantial improvement in the knowledge and understanding of science, and especially of biology, among our students. If this improvement were to occur, then we could eliminate certain parts of the curriculum in a course such as the one I have described. We could then devote more time to other parts and treat them in greater

depth, for instance the ecological sections.

Thirdly, if it is deemed necessary to give all graduates a background for understanding the environment and man's responsibilities to himself and to it, whereabouts is such a course to be fitted into the present degree structure? Most degree courses are necessarily pretty rigid – certain training being considered essential to train professionals. I have encountered not a few students who have reluctantly given up the idea of doing our course because they were unable to fit it into their schedules. Should we make such a course an essential part of a degree programme? If not, how do we encourage students to take such a course in worthwhile numbers? Should we present a choice of such courses and either state that one such course must be taken during a degree or merely encourage students to take one? Whatever we choose to do in this direction, I am sure that it is necessary for action to be taken within the university as a whole. It is no use for one school or department to decide to put on a course of this kind. The matter should be one for consideration by the staff as a whole, from the highest members of the administration down to the lecturers who advise students on their course structure. It is a matter surely for a policy decision.

Finally, I would not for one moment suggest that a course in biology of the kind described here is the only way to impart environmental education at the tertiary level. There are many ways to attack the problem. However, to those of you who are biologists, I would suggest in the light of my experience with this course, that a course of this kind can be an effective method of arousing awareness. And, more importantly than this, it can help to provide a sound educational basis upon which future citizens may critically evaluate their own and others' actions in tackling the problems confronting them.

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COMMENTS

Peter Rudman*

As Dr Mercer has indicated, great concern is being shown in the U.S. about the environmental crisis and I would like to enlarge upon this background. Fortunately, many of their universities have responded to this concern by offering tertiary level courses in environmental education. Although most of these courses are not compulsory, the type of liberal education given in the American system of university education ensures that a few students have the opportunity to attend such courses and that a considerably greater number of both science and non-science students will attend courses in biology which have an environmental emphasis, and so have some appreciation of the problems which we are creating in our world today.

In order to stimulate the discussion today, I will present some of the actions and comments of our American colleagues.

In 1965, the Commission on Undergraduate Education in the Biological Sciences (CUEBS) in the U.S.A. organised a colloquium on 'Biology in a Liberal Education' (1967). The Commission recognised the need for re-assessing the importance of a biological education for the non-scientist in view of the rapid expansion in knowledge and its application to everyday problems. As one colloquium participant said:

> "This Colloquium offers us a chance to examine the position of biology as part of the liberal arts curriculum. We should start by asking ourselves a few questions. What should every educated person know about biology? Is this the same material the potential major should master? How best can biology be taught as a liberal arts subject?"

It seems to me that we are gathered here today to ask these same types of questions, except that we are unfortunately meeting five years later. However, the intervening five years have seen tremendous changes in the attitudes of many people, with an increasing awareness of the seriousness of the environmental situation in which we find ourselves. And so we might reflect on the conclusions of our American colleagues, who unanimously adopted a resolution, a portion of which is pertinent to the main theme of this paper:

> "We believe that every educated person should obtain a sound knowledge and appreciation of the biological sciences."

and an even stronger statement followed:

> "Although intimately related to the physical sciences on which it draws, biology is sufficiently unique both in subject matter and methodology to warrant separate study. It cannot be considered merely as one example of scientific achievement for which a non-biological science can be substituted."

Unfortunately, although there was such strong agreement on the importance of biology in a liberal education, there was little agreement as to essential components of such a course, whether it should emphasise the investigational approach, or whether it was desirable to have a common course for biology non-majors and biology majors. There was considerable disagreement also as to the teacher's role in connecting the subject matter with its possible social implications, a number of participants fearing that the teacher's zeal to relate biology to contemporary problems of mankind might cause him to propagandize in favour of one political issue or sociological bias; in other words, to impart opinions which were less likely to have been scientifically derived. *They concluded that the manner in which the social implications of biology are introduced into the classroom is of considerable importance. Where it is appropriate to illustrate a biological principle, they concluded that certain sociological problems have a rightful place in the classroom.*

Mindful of the inability of their first study group to come to many conclusions, the CUEBS decided to form a further committee to pursue the problem of biology for the

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non-major. This later investigation was conducted by letter. The organisers considered the response overwhelming, not only in the number of replies received, but also in terms of the ideas expressed. There was clearly a major trend in the written replies, this being that the course for non-biology majors should deal more closely with the relevance of biological principles to man and his future. It was recognised that a point of primary importance to be imparted to the non-major – as well as to the major – is the difference between science and technology, between pure and applied research. It was also recognized that a man-centred course could easily blur this distinction. However it seemed that it was still possible to use man as the type-organism when dealing with, say, ecological principles, so bringing in factors such as over-population and pollution without conveying the impression that biology existed solely for the benefit of man. Some of the writings which led to this conclusion are quoted below:

> "A liberal education in biology should provide the social science or humanities major with scientific knowledge basic to understanding the great problems facing mankind: food and population, race, environmental pollution, resources and the future."
>
> "The course should be designed to enrich the lives of such young people by making them more aware of the biological phenomena taking place in themselves and their surroundings."
>
> "The student should leave such a course with some understanding of the nature of the scientific enterprise, how biological ideas grow and change with time, the meaning of science-based culture, some acquaintance with the sociology of science and the relation of biology to human progress and welfare."
>
> "It is extremely important that we do not graduate hundreds of thousands of scientific ignoramuses, because science and scientists are ever more powerful in directing the course of society, not only in our country but generally in the world."

In summarising this part of the report, the editor stated:

> "The large amount of attention given to human ecology was perhaps the most outstanding feature of the letters in regard to course content."

Although the editor's conclusion speaks for itself, I cannot let pass the opportunity to present to you what, to me, was one of the most telling statements in the report:

> "I think of the students as future citizens in a world in which the human ecosystem is getting out of kilter – they will be involved with decisions on population, on environmental deterioration, on human behaviour."

This statement, made in the United States in 1968, is surely applicable here in Australia in 1970. In the intervening years, the United States has continued on its pathway to environmental destruction which began at the time of the industrial revolution in Europe. Possibly, the United States of America is five years ahead of Australia in science and technology, but it is clearly five years ahead in its destruction of the environment. Fortunately for Australians, other scientific inventions have allowed us to become aware of the American environmental crisis, their concern, and their actions to counteract the undesirable tendencies at an early stage.

We would be foolish to ignore their warnings and their thoughts, particularly about education of the public and in particular the education of our future leaders. Although there is evidence that industry and government in Australia is awakening to the facts, there is still a lamentable lack of appreciation on their parts of the gravity of the situation; one needs only quote the recent political-industrial developments over the Great Barrier Reef and the Little Desert to realise the magnitude of the problems and the feelings that they may generate, frequently based upon opinion alone and with an absence or suppression of facts.

Although the adults of tomorrow need education today at the primary school, secondary school and at the tertiary level where applicable, we are in this session only considering the tertiary level. Dr Mercer has indicated to you, and later Mrs Sargeant will add to this, the type of course being given, all too infrequently, at the universities in this country. The position in the Colleges of Advanced Education is no different, for here again the education of the liberal arts student in the environmental sciences is neglected. There is, however, some hope that it is not too late to rectify this situation, for a number of new Colleges have been created or are being created. It is in these Colleges that we can hope for, indeed expect, that new courses for the liberal arts student will be developed. In my own College, the Canberra College of Advanced Education, an autonomous institution which admitted its first students in Applied Science and Liberal Studies only eight weeks ago, we are offering a semester unit in Human Ecology which all students in the College will be encouraged to attend; whether they are prepared to do so, or

whether they will receive the necessary encouragement to do so from the academic staff of the College is not known, but the enrolment from first year students for the course, which is scheduled for the second semester of 1970, is disappointing. However, present indications are that a considerably greater number of students intend to enrol during their second year of full-time studies. Although the Human Ecology course will be a modest 50 hours in the first year or two, the emphasis on biological resource management in the School of Applied Science (which includes such studies as Land Use, Resource Management, Conservation, Pollution, Ecology, Recreation, Urban and National Parks Administration, Wildlife and Fisheries Biology and Management) means that we are particularly interested in the nature of our environment and its relationship to people.

Yesterday, considerable importance was attached to the need for conservation courses to be given in primary and secondary schools throughout Australia; clearly the question of training these teachers is of utmost importance, and I am pleased to be able to say that the School of Applied Science in the Canberra College has a co-operative scheme with the newly created School of Teacher Education at the College which from 1971 will allow student teachers undertaking the four year course to major in conservation. The School of Applied Science already has a similar arrangement with the School of Liberal Studies, whereby student librarians may take a major in conservation.

The Canberra College is currently undertaking a survey of the regional needs in landscape architecture, and should such a discipline eventuate this would require close co-ordination with the biological resource management courses mentioned above. Thus we expect to place greater emphasis on the environmental sciences and on human ecology in the coming years. It is worthy of note that the biology undergraduate students have already formed a Society for Environmental Concern, and have invited students from all other disciplines to join their society so that they may benefit from discussion and from hearing guest lecturers.

Finally, I will outline what we consider to be the essentials of a course which will provide all students, including those who will major in biology, with an awareness that nature is no longer in control of man's destiny, but that man is now in control of nature's destiny. We do not propose to teach cell biology or microbiology in the course, but rather to emphasize the relationships that exist between man and his environment by drawing upon both scientific and sociological work. Thus it will be essential to study genetics so that we may understand the effects of controlled and uncontrolled mutations in plants, animals and humans. This will also enable us to introduce the student to the consequences of medical research, such as increased life expectancy, birth control, survival of those who are 'not fit' and so to population problems such as food shortage and the behavioural consequences of crowding. Ecology and conservation will be introduced so that the competing demands for space may be placed in a biological context which will make the student aware of the long-term effects of misuse of land and of transformation of land use.

The pollution of our land, sea and atmosphere will be examined so that the gain and the undesirable effects can be evaluated in relation to ecology, conservation, increased food production and standard of living.

Those of you who are interested in this area of study will appreciate that there are many aspects of the subject which have been omitted, and which you may feel should be included. We are aware of these omissions but have at this stage in our development decided to make a start on the course in Human Ecology outlined previously, but approach it with an open mind so that, should sound suggestions be put forward, such as we hope will be the case at this meeting, then the course can be modified to allow their inclusion.

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Delys Sargeant *

The teaching of Biology to non-science students was pioneered in Australia by Dr Lena Thomas who began the subject of Social Biology in the University of Melbourne in 1946 and who is still in charge of this course. We have developed this subject by constant experimentation with the content of the course, as well as with techniques of teaching and examining. Feedback from students has been obtained with the help of the University's Higher Education Research Branch.

Social Biology is a compulsory, full first year Science subject for 100 (quota) students enrolled in Social Studies (in combination with Arts, Commerce, Law or Education degree courses) at Melbourne University. During 1970, a small number of other students, doing M.A. preliminary, Mechanical Engineering and Town Planning, were accepted for the first time. The subject comprises 80 lectures, 2 hours of laboratory and one tutorial per week, plus two selected field assignments. Two lecturers are responsible for the lectures and tutorials and they share the laboratory demonstrating with two part-time demonstrators. The subject is financed jointly by the Department of Social Studies (Arts Faculty) and the Department of Physiology (Medical Faculty) and, as such, occupies a unique position for a science subject at Melbourne University and, to our knowledge, within Australia.

It was felt that we could contribute most to this Conference by discussing the ways in which we have resolved many of the problems of teaching a science subject to non-science students. We felt that a detailed discussion of the content of our subject might be too specific, and so the aims and general outline of the subject are included as an appendix. More detailed information regarding the content is available on request.

At the outset, let me state quite clearly that we do not pretend to present primarily a course on "environment". Rather, we attempt a comprehensive study of man as an animal within, and as part of, his total environment. This study has been closely related to the changing psycho-social roles man has filled during his biological and cultural evolution.

Findings relating to the administration and teaching of the Course

1. *Whether the subject is optional or compulsory within a tertiary course* makes a tremendous difference to the attitude of the student towards scientific material and will consequently make different demands on the teacher in terms of the progression and the manner of presentation of the material. We have concluded that there is more interest and involvement in the course if the subject material is introduced, in order, from a close study of the individual and extending *out* from personal experience to more general matters (e.g. physiology of sexuality in the individual; family planning; population dynamics and explosion; corrective legislation; possible ecological consequences at community and biosphere levels).
2. *The maturity of the students.* Notwithstanding a very high matriculation aggregate score for all selected students, those who are over 25 years in age have demonstrated greater application and motivation towards the subject throughout the year. This does not, however, imply a more continuing interest in the subject-matter after graduation.
3. *The varied educational background of the students.* Since our course assumes no prerequisite secondary school subjects, we have experienced considerable difficulty in determining quantity and type of information which is optimal for concept development, while minimising the acquisition of the information as an end in itself. This has been the subject of considerable study and has resulted in a great deal of variation in the material selected. We have found that tutorial groups formed according to the students' previous level of experience in related subjects have been most economical of both teacher and student time. Special (elective) carrel audio-visual material has been prepared for students with no science or biology background, and this also reduced demands on tutorial teaching staff.

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4. *Assessment.* The examinations are spread over the year to reduce examination pressure on students at the end of the year. To increase the students' retention of important but difficult integrative concepts, we have made a practice of presenting questions involving such concepts for tutorial discussion, with the student being told that these same questions will be on the final examination paper. From student feedback, it is evident that this material has been retained rather than merely crammed for examination purposes and then quickly forgotten.
5. *The problem of relatedness to other subjects concurrently undertaken.* We consider it vitally important that a constant liaison and interaction be maintained with the teachers of other subjects and with people employed in the professional field appropriate to the student's course.
6. *The year in which the general subject is taught within a 3, 4 and 5 year course.* This will make a considerable difference with regard to the nature of the material that should be included (i.e. the degree of relatedness to other subjects studied by the student during the same year).
   The amount of conceptual material that is likely to be retained and integrated with other study areas will depend on preventing the isolation of the study from material presented in other courses. Since Social Biology has been taught in the first year of a 3 or 4 year course, we have conducted second and terminal year seminars to apply the concepts developed in first year more directly to the professional course of the students (in this case, social work).
7. *Availability of adequate staff.* From long experience (over 20 years), we find that the best staff to teach an integrated, unitary science course for non-science students, are not those working towards academic progression. The simple reason for this is that greater reading research demands are made on the staff than by any other first year science subject and therefore less time is available for laboratory research. On the other hand it is most necessary that the teacher is in continuing and close contact with people who are conducting research in many different areas.

In the teaching of a subject which involves many extensive conceptual integrations, no group of experts can ever substitute for the well-read teacher who is experienced in a variety of research areas. This is the firm conclusion of the lecturers in this subject who are experienced with many teaching methods and in many areas of science.

We recommend that in the establishment of such a tertiary course, the instructors should be selected on the basis of background academic experience over a wide range of subjects and that their posts be considered as research-*teaching* ones.

The value of making intensive studies of various areas, rather than presenting surface generalisations, has been shown by the responses of students to tests in which they evaluated their total course over the preceding two years. The sections of the course that had been treated in greatest depth by the teachers were considered by the students, not only the most difficult, but also the most worthwhile.

Needless to say, it is much easier to supply a semi-popular course lacking in depth than to take the necessary time and patience to develop a strongly based one with the present fashion for environmental studies and the very small number of people available who are adequately trained to teach them. Such superficial courses are likely to become common, unless great responsibility is shown by staff selection committees.

In conclusion, I would like to reiterate the point that we set out in this subject to provide environmental education, not *per se*, but as an integral part of the study of the bio-social aspects of man within his total environment. In this Conference to date, there has been a rather heavy emphasis on man's relation *to* his environment when we should, I think, examine him *within it*. An emphasis on the crises in the physical environment is perhaps understandable but the crises of man's psycho-social environment are just as important and less well understood. I note here that socio-biological education becomes increasingly necessary for all citizens if they are to be able to resist the anxiety-making, increasingly sophisticated, biological reporting of the mass media. The effects of the increasingly large number of humans in the world are not to be measured merely in terms of dirty water and aerial garbage, but also in terms of the inadequacy of provisions for leisure and solitude, which are difficult to quantify but necessary nevertheless for the peculiarly individual requirements of *Homo sapiens*.

D. SARGEANT

Appendix: The Aims and Outline of the Course

Aims

1. To develop the capacity of the student to obtain and evaluate information according to scientific methods. This is achieved by his participation in practical work and field assignments which are specially designed to test as much of the theory as is possible.
2. To extend the student's awareness of the needs and processes of his own body, and of interactions between humans and other organisms within their total environment. This is developed through a sound study of basic biological principles.
3. To select from a wide range of biological information that which is most likely to be relevant to significant social problems. So many of these problems arose originally through lack of knowledge of biological laws and order and are now perpetuated by a refusal of decision-makers in society to apply the knowledge which now exists.
4. To develop the student's capacity to apply this knowledge to social manifestations of biological processes – for example, the biological principles involved in either family planning or political decisions regarding population control.

Outline

The study of the physiological functions of man as a total organism and of the extent and limitations of his adaptability to variations in his total environment. The pathological consequences of these limitations being exceeded are explored. Cybernetic principles of regulation and control are applied at the levels of the cell, the whole organism and the ecosystem. Considerable study is made of the function of the central nervous and endocrine systems, particularly in relation to physiological bases of behaviour.

2. The individual's varying nutritional requirements related to life span, occupation and sex are studied in the context of background, culture and income. Studies of the nutrition of selected individuals and groups in relation to social factors are undertaken.
3. The principles of genetics and evolution are applied to the study of growth, development and body function in both health and disease. Modern eugenic policies are examined in the light of these principles.
4. Principles of population variation as part of an ecological and evolutionary process are studied, together with some analysis of human population trends. In the study of epidemiology and immunology, special emphasis is placed on the health of the community and the prevention of disease.

THE RESPONSIBILITIES OF THE MASS MEDIA. By John Bennetts*

In approaching the task of preparing this paper, I assumed that I was expected to talk about what the media should do in the environmental crisis. I must begin by warning you that my paper is descriptive rather than prescriptive; it talks more about what the media are likely to do than about what they should do.

There are widely differing opinions about the responsibilities and functions of the media, and about what they should do in this, or any other, crisis. Communication research may indeed be a "growth industry" among the social sciences, but it is still in its infancy. We really know very little about the process and effects of mass communication. Until we know more, we should, I suggest, be careful in our assertions about the responsibilities and obligations of the media.

The London *Times* in a famous editorial in 1852 asserted that "the duty of the journalist is the same as that of the historian – to seek out the truth, above all things". An admirable statement, but not really much help in coping with the problems you are concerned with.

Max Walsh of the *Financial Review*, speaking at the recent Canberra Summer School of Journalism, said the main reason – perhaps the sole reason – why the press had a social responsibility over and above that of other commercial organisations was that the press itself proclaimed social responsibility as one of its aims. Walsh went on, and I quote – "If they want to be taken seriously, it is necessary for the Australian newspapers to print something more than pious platitudes. At the moment they show a distressing tendency to engage in shop window responsibility. When you go into the store to buy some, they really have none in stock".

In his monumental work on the Australian press, Henry Mayer (1968) says that where there is a fair degree of agreement in society about the functions of a controversial institution, that agreement is likely to be expressed in legislation. But where agreement is lacking, it is more likely that we shall find few laws and plenty of dispute about moral obligations. In societies such as ours, Mayer discerns three major views of the press – it is seen as merely a business; it is seen as some sort of public utility; or it is seen as a mixture of both.

Mayer notes the opinion of the 1949 British Royal Commission that –

> "The Press cannot be considered purely as an industry; the inescapable fact that it is the main source of information, discussion and advocacy imposes upon it responsibilities

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> greater than those resting on an industry which does not deal in information and ideas."

But then, with typical irreverence, Henry goes on to assert that talk about "a responsible press", though comforting, is empty. He asks – what does "Press" mean in this context? Are we talking about the responsibilities of owners, editors, managers, journalists, news sources or what? To whom is this Press supposed to be responsible, to a given country, to humanity, to its readers? All three are groups with conflicting demands. What is to be the scope of this responsibility? And on what basis, by whom and by what methods are issues such as these to be decided?

> "The confusions inherent in all conceptions of the functions of the Press are ineradicable, for arguments about them are, in a muddled way, arguments about what particular interests in society would like newspapers to be. As long as there are conflicting ways of life, there can be no single conception of Press functions" (Mayer, 1968).

In the light of these and similar arguments, you will agree, I hope, that I am manifesting prudence rather than cowardice when I decline to prescribe a course of action for the media in the environmental crisis. I think I will serve you better if I try to describe how the media react to crises generally, and how some people in the media perceive the environmental crisis. This, I hope, will lead to some useful conclusions about how people like yourselves, who are concerned about the environment, may use the media.

Obviously, you want the media to disseminate information about threats to the environment, and about methods of preventing or repairing damage to the environment. Presumably, you hope that this information will be disseminated in a manner which will alert ordinary citizens and the authorities to the dangers you perceive, so that the citizen will act to protect the environment, and so that the authorities will be persuaded to do likewise. This, of course, assumes a cause and effect relationship between information and action.

Now, the prime business of the mass media is the dissemination of a special kind of information known as "news". "News" is what sells newspapers; "news" is a commodity which attracts large numbers of listeners and viewers to radio and television stations. The media also deal in information which is not "news" – information of a less exciting kind which is disseminated in feature articles and documentary programmes. But the owners and controllers of the media depend mainly on "news" to achieve the circulations, and the listener and viewer ratings, which boost revenues and keep them in business.

So I am submitting that the information you wish to see disseminated about the environment is more likely to be given space in newspapers and time on radio and television stations, and is more likely to capture the attention of readers, listeners and viewers, if it is "news"

One of the best textbooks of journalism,Curtis MacDougall's "Interpretative Reporting" (1957) says this about "news":

> "At any given moment, millions of simultaneous events occur throughout the world. Someone dies, someone is born, someone gives a speech, attends a meeting, takes a

> trip . . . All of these occurrences are potentially news. They do not become so until some purveyor of news gives an account of them . . . Professional news-gatherers judge the potential interest and/or importance of an event before deciding whether to render an account of it, thus making it news. These news-gatherers are men, not deities. They possess no absolutist yardstick by which to judge what to report and what to ignore."

But, says MacDougall (1957), editors and journalists in most open societies have similar criteria by which they determine the news value of the occurrences from which, each day, they must select those items for which newspaper space and news bulletin time are available. These criteria may be superficial or erroneous, but they have been tested by years of experience and, rightly or wrongly, they are in vogue in all news rooms.

And these, according to MacDougall, are the qualities which determine the news value of a piece of information – timeliness, proximity, prominence, consequence, human interest.

The significance of *timeliness* is obvious. Most journalists are brought up on the adage that "nothing is so dead as yesterday's news". To warrant dissemination through the media, a piece of information has to be new, topical and up to the minute. *Proximity* is deemed important because journalists believe that an event is more likely to interest readers, viewers and listeners if it occurs close to home than if it occurs far away. All men may be created equal, but some are more newsworthy than others. Rightly or wrongly, the *prominence* of people who say things, or do things, or to whom things happen, helps determine whether they figure in the news. The significance of an event, what MacDougall calls its *consequence*, helps determine whether it is reported front page, back page or not at all. Finally the purveyors of news look for *human interest*, because they believe readers, listeners and viewers are interested in the lives and welfare of others, in the successes and failures of individuals and communities.

You may well say that when tested against those criteria, most if not all of the information you produce about the environmental crisis is news, and therefore deserves the attention of the media. But it has to compete for that attention with a flood of information about other crises. To rate acceptance as news, your information has to be presented in an interesting and arresting manner, and this may involve some dramatization, some departure from what you might regard as proper scientific detachment and balance.

The theme of the Journalism Summer School I mentioned earlier was "The Social Responsibilities of Journalism", and it produced an illuminating exchange between Stephen Boyden and Adrian Deamer, the editor of *The Australian*. Boyden pointed out that newspapers tended to play up isolated curative achievements in medicine such as heart transplants, while ignoring less spectacular but more important basic research which is being done on the prevention of heart disease. Deamer's reply was that newspapers played up heart transplants because editors were aware of the low threshold of reader boredom. He added that doctors seemed

similarly aware, because medical spokesmen throughout Australia had pumped out information and comment on transplants while saying little about basic research.

The media may be trailing behind public taste and capacity; people might hold still for rather more serious news than we give them. But the judgment of the men responsible for producing daily newspapers and news bulletins is that a degree of drama, of sensation, is needed to capture public attention.

I remember hearing an American journalism teacher explaining and justifying this with a story about a farmer who took his mule to a trainer. The farmer emphasised that he wanted the trainer to treat the mule kindly. The trainer assured him he would do so, but began the first lesson by hitting the mule between the eyes with a piece of four-by-two timber. When the farmer protested that this was a breach of the undertaking that the animal would be treated kindly, the trainer retorted – "I'll treat him kindly, but first I must capture his attention".

Believing that they have captured the attention of part, at least, of the Australian public, newspapers are devoting more space to educational features, such as the *Sydney Morning Herald's* "Behind the News" series. Information about the environment undoubtedly will be published in these features, and in documentary programmes on radio and television.

But environmental data, it seems to me, will have its greatest immediate effect if presented as news – on the news pages of the papers and in the bulletins of the radio and television stations.

The media may be persuaded, from time to time, that the environmental crisis is more important than other issues competing for their attention. But I see no evidence at present that they regard it as radically different from other crises, or requiring drastic changes in their methods of reporting and interpreting public affairs.

Deamer, at the Summer School, posed these questions – How does the responsibility of a newspaper in this field (i.e. the environmental crisis) differ from its responsibilities in other areas? Do newspapers lead public opinion or follow it on issues such as this? Should newspapers give a lead or leave that to the experts? He recalled that *The Australian*, in 1969, ran a series of articles called "Doesn't anybody care?" describing threats to the quality of life in Australia – the dangers of pollution, the desecration of natural resources, the lack of proper town planning and so on.

He pointed out that a basic preoccupation for all newspapers was commercial success, and commented – "Each newspaper tries to know its readers and aims the paper at them, hoping to keep its constant readers and pick up new ones along the way. To be effective as an organ of opinion, whether one is reflecting opinion or trying to create it, a newspaper must have as many readers as it can find." He warned of the danger of boredom among readers, and said this might frustrate newspaper campaigns on social issues. And he concluded – "The

only way to achieve the aims we are discussing here will be through prolonged battle, with newspapers allied with experts hammering home the lesson that the quality of life is important".

In reply to some questions I put to him, my friend and colleague, David Bowman, assistant editor of the *Sydney Morning Herald*, found time last week to set down some ideas about what his paper might do in the environmental crisis. I have his permission to quote from his letter. He suggested the use of a simple catch-phrase such as "The Environment" to help create awareness of the environmental crisis, and he went on:

> "Whitlam has been preaching for years about the quality of life in the cities and the need for newspapers and others to do something about it. With a descriptive word like Environment to push he might have got a lot further in much less time.
> "I would not argue the importance of the subject or the need to keep it before people. I consider the case proven and the problem rather a technical one – for the Herald at least. But any newspaper worth its salt ought to have a positive approach to the questions involved and not just a soggy take-it-as-it-comes policy, if that can be called a policy.
> "To return to priorities. There are so many facets that the whole subject could just trickle away in a newspaper in uncoordinated effort. The only practical course (besides creating an awareness throughout the staff) is to focus upon particular aspects in an interesting and constructive fashion. That way there is a chance of making some impact. For example, the aspect of The Environment that is humming (a good word) along very nicely at the moment is pollution. The whole world, it seems, has suddenly discovered it. People are interested in it. So we have a problem now of how to tell them about it, and whether to campaign on it.
> "The Herald was reasonably quick off the mark with a series of good articles about last September by Margaret Jones. But I think there is a good deal more to be done before the question of campaigning seriously arises – a good deal more, I mean, in simply informing people of the dangers that surround them.
> "The need to campaign may be clearer when the State Government reveals its legislative plans. That as I see it is the real need: legislation that will clean things up. If the legislation seems inadequate then newspapers ought to push hard for something stronger; and to do that it may be necessary to campaign over particular cases. At the moment I believe the need is rather for revelation . . ."
> "I would not like anyone to underestimate the difficulties that face a newspaper in this field. It is a tangle that calls for the greatest journalistic skills even to begin to untie it . . . those skills are not always available when and in the numbers that one requires . . ."
> "From this you will see that I believe firmly that a newspaper has responsibilities with The Environment. It should not just wait for news to happen. It should dig for it. How it treats it will depend upon the kind of newspaper it is. For my own paper, my idea is that we should concentrate on supplying information, supported in season I hope by editorial opinion. Whether this would need to be screwed up to campaign pitch would depend on developments."

A source in the Australian Broadcasting Commission tells me that "Four Corners" and "This Day Tonight" will be tackling the environmental crisis "when newsworthy opportunities arise" – and I repeat that last phrase, "when newsworthy opportunities arise", because I think you gentlemen should keep it in mind. You have the necessary prominence, and the information which you are able to provide has the necessary timeliness, proximity, consequence and human interest, for The Environment to be almost continually in the news. I understand that the ABC also has, coming up, a film on bad suburban development, a programme on the dangers of pollution caused by oil, and a "Chequerboard" show dealing with the effects of bad environment on individuals.

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From what has emerged in this paper so far, it is clear that The Environment has become a topic of interest and concern to the media and their readers, listeners and viewers. General reporters are being assigned to write stories about environmental problems; some organisations have appointed men to specialise in the subject. *The Age* announced on February 21 that it believed conservation would be the most important public issue in Australia in 1970 and that it had accordingly appointed a senior reporter as a full-time Environment Writer. Here, I think, I must say again that you people, as the environmental experts, have a part to play if you want the media to continue paying attention to the topic.

Environment writers have to earn their keep in the hard cold world of journalism. They will need your help and guidance to produce sufficient copy, day after day, to satisfy tough-minded executives who tend to measure a reporter's worth in terms of the volume of copy he produces. At the recent Journalism Summer School, Stephen Boyden (1970) outlined his ideas about an environmental information clearing house. Journalists who heard him were, I think, unanimous in their endorsement of the suggestion that a centre, staffed jointly by scientists and journalists, should be established. The centre would collect, collate and disseminate what Boyden called :

> "hard facts relating to environmental change, the views of experts on the significance of these changes, as well as details of legislation introduced in various parts of the world to counter environmental threats."

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COMMENTS

Nicolas Haines*

Hitting a mule between the eyes to get its attention was not, I believe, a teaching method which appealed to John Bennetts. To stop the poor beast plunging over a cliff, however, even he might reach for a piece of two-by-four. Yet what sort of muleteer would wait long enough for the brute to get into such a fix? An academic one, I dare say; one, that is, who acted (or didn't act) in the spirit of Mr Bennetts' reluctance to say more about responsibilities until "we know" more about mass communication. The muleteer who says he couldn't get the mule's attention probably has some kind of legal or even moral defence; in the unlikely event of his claiming that he could not act because he did not know enough about the mule's intentions, the terrain, or the effect of a fifty-foot drop on the creature's vital processes, he would have a splendid academic defence.

What have we to say about the problem of bringing attention to threats to our environment? Have we anything to say about the more complicated question of the connection between theoretical knowledge and practical wisdom in this "crisis"? My comments are made from the viewpoint of the Centre for Continuing Education, a department of the Australian National University, which has a special interest in the educational opportunities promoted by the theme of this Conference.

Mr Bennetts referred more than once to the Summer School on the Social Responsibility of Journalists. The Centre for Continuing Education helped organize that School and one or two of us took part in its less formal sessions. After Stephen Boyden's paper, I found myself wondering whether one ought to give up teaching and go back to preaching. His biology was casting long, grim eschatological shadows. The doubt recurs here. What has education to do with "crisis"? If the Day of Judgement is at hand, would not the prophet's mantle become us more than academicals? Wouldn't we get more attention that way? Then, on that other question about theory and theoretical knowledge: Dr Francis West, in an article in the *Canberra Times* last week, invited university teachers and research workers to see themselves as engaged in a "passion ss search for passionless truth": whatever we do with that invitation, those who accept it mi t find it hard to reconcile with talk of "crisis", with the urgency which is the only rational response to the warnings we have now been given.

Let me show you, for a moment, how such problems look and how they emerge in the work of continuing education. You may have seen a brochure about a Seminar being arranged by the Centre in consultation with the National Parks Association. The Seminar deals with problems and processes of conservation. The aim is not to take sides or publicize a cause, but to bring together conservationists and administrators so that they can familiarize each other with their demands, their problems and their procedures. The activity is "academic" in that it is not partisan or propagandist. On the other hand, while it aims to inform, bringing such resources of theory as the academy possesses to bear, it is also critical in the strict sense in that it recognizes the daily problem of decision making. This is an example of how we see the work of continuing education as an agency of the university; it also exemplifies aspects of those two problems, of getting attention and reconciling the theoretical with the practical need, which were either raised by Mr Bennetts or implied in what he said.

On the general aims of continuing education as these relate to the work of this Conference, we have to hand various statements and declarations by such bodies as the United Nations (in their Declaration on Social Progress and Development) and the Council of Europe. Both these sources draw attention to the connection between continuing education and public participation in the management of affairs. One contributor to the Council of Europe's Information Bulletin on this subject, F. Bonacina of Italy, writes that the need is

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> "to place the current changes under the control of the whole of society, to carry out research on ways of life and on the values underlying this process of change, and to give the whole of society an awareness of where it is going". (Information Bulletin, Documentation Centre for Education in Europe, 3/1969, p.35)

That is the broad aim of continuing education and our brief for direct concern with the problem before you.

Yet we are part of the Unversity and as anxious for the preservation of its style of life as any. This brings me back to the point about "waiting to know" the connection, whatever it is, between theoretical satisfaction and public responsibility. Are we engaged in "passionless search for passionless truth" and, if so, does this license indifference to human good? Is it essential to the work of the university that its scholars, scientists and research workers should, in their work, be immunized from public cares? And, if so, how do we persuade the public, whom we now warn of the dangerous applications of our research, to subsidize this professional indifference? Hard as it may seem, continuing education has to find a foothold on this very slippery ground, for the public as well as the academic weal.

The more pressing, or at least more publicized, question about attention may also be looked at from our point of view. Compare our position, in continuing education, with that of the primary and secondary schools. They don't have to advertise as we do with these brochures on conservation (which I am now advertising for the second time in this paper). They have captive audiences, though this does not, I know, guarantee that their attention will be captured. Undergraduate schools and other institutions of tertiary education also do not have to advertise; they may even find it fairly easy to secure attention in the lecture room and the tutorial. Ought we not to leave environmental education to these institutions which are able to conscript so large a part of the population and command so much attention with comparative ease?

I wish we could. That is, with the weary, the anxious part of myself, I wish we did have to deal with a steady environment, a world which does not change, and with future managers of affairs who could be programmed once-and-for-all to know their environment and deal with it in ways conducive to the general good. I wish I were a Platonist (in this sense); but the environment which troubles and nurtures us is Heraclitean; what is more, men modify it daily without always knowing how, let alone why, and with far too little appreciation of the consequences. Therefore, what is learnt today may have to be unlearnt tomorrow; the world we were schooled to come to terms with may have dissolved before our lessons can be applied. Besides, decision-making, whether of the "micro" or the "macro" sort, is an adjustment to a changing environment of agents who have themselves changed, and these are reasons (familiar enough to us) why one must come to speak of "continuing education" with whatever consequences must follow for the whole range of educational enterprises.

Yet, still we are left with the problem of securing attention without coercion. Or, to savour the full irony, of having no compulsion save the most ancient and fundamental – that of the necessities of survival – to apply to a species insensitive to such necessities and rendered so, in part, not only by over-excitation and the wolf-cry syndrome, but also by our own lofty assurances that one must neither judge nor act until a great deal more is known, a great deal more research has been financed and completed. Should we leave it at that? "Crisis", "emergency", traditionally authorizes the few to act for the many; why not now?

The philosophy of continuing education, as I understand it, requires us to take up a different position. That is what I anticipated when I spoke earlier about the educational opportunities promoted by the concerns of this Conference. We have here, I believe, an opportunity to promote the slow, painful development of responsible society. By "responsible society", I mean a community which comes to terms with its environment by a control of resources based, broadly, on informed and critical public participation in management of affairs. Democratic institutions and traditions are a foundation for this but no more. I doubt if we shall retain them long if we are content with so little. How can we translate these environmental urgencies not only into compelling symbols of crisis, as journalists and others in the media are doing, but into a style of life, into habit, into routine, into principles of organization and rules of conduct?

Stephen Boyden and John Bennetts have both spoken of the need for an Information Centre available to publicists and educationists. The Centre which I represent is interested in

this but also in a task more within its competence: the mobilization of all enterprises which have educational facilities and opportunities and the adaptation of their special functions to the particular problems of environment and the wider concerns of responsible society. If we set aside stereotypes of what is and what is not "education", we may discover that we have considerable resources. Everyone sees this in newspapers, radio and television: too readily, perhaps, it is easy to pass on to them responsibilities which ought to be more widely distributed. Quite apart from numerous voluntary associations, there are in our community large-scale organisations, industrial, military and administrative, which already acknowledge educational obligations. If ways could be found of adapting to their special needs the information we think essential; if ways could be found of doing this, and all their educational work, to the benefit of those critical and evaluative skills and insights necessary to decision making, we would be dealing with the environmental crisis at levels of habit and interest, less dramatic, but in the long term more effectual. We would also, I think, be promoting the development of responsible society.

Peter Pockley*

One of the crucial problems facing the novice broadcaster is that he has little theory or formally established principles to follow. I submit that we have fewer guide-lines than pressmen have, partly because of the very newness of our media compared with theirs. In the final analysis, we operate largely on the basis of experience, precedent and rule-of-thumb. Consequently, I have no authorities to quote or references to provide at the end of this paper.

Broadcasters display a pragmatic approach to their work. In many ways, this is no bad thing, for we do at least enjoy the potential to break new ground all the time, and in my book, this is the guts of good broadcasting. We are able to exercise initiative; we can be genuinely creative; we can evolve new forms of presentation without too much precedent holding us back. If we suffered a load of professional or "ethical" restrictions, we would lose the drive, relevance and immediacy which characterise good programmes, irrespective of the topic being covered.

But my feeling remains that, despite their acquaintance with radio and television through long hours of listening and watching, few people know how the broadcaster's mind works in action and how he exercises his mythical "responsibility". So I am giving here a short account of one broadcaster, speaking very personally – just thinking aloud – about how *I* go about *my* job.

But prior to this, I have first to insert a few disclaimers about what I cannot do in this paper. First of all, my experience is limited to public service broadcasting; I have no experience in the commercial field. I would suggest that, although our audience research would show that most of the delegates at this symposium would watch and listen to the ABC in preference to the commercial channels, you still should not ignore the latter as being major outlets in the mass media in Australia. Secondly, the ABC Science Unit, of which I am the Head, is only a small group; we have, for instance, only 45 minutes of regular programming per week on radio, and we can't do much in that time, when compared with the total number of hours which are broadcast and telecast each week. Nevertheless, the Science Unit does work closely with other ABC programmes and departments, and it is worth noting the main point of my paper here, that, irrespective of the type of programme considered, environmental issues have to *compete* for the very limited time available with other news and other issues and other personalities.

My third disclaimer involves an appreciation of a further distinction in the styles and aims of different programmes; this is necessary because it involves the context in which you have to work if you want to get on the air. The programmes which come under the Science Unit are directed in general towards adult audiences; in conjunction with the far greater output of News and Current Affairs and other programme departments of the ABC, these do not seek to educate our audiences in any formal way. We seek to present significant information,

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viewpoints and personalities; collectively, these go towards expanding the informational backgrounds of our audience, and these in turn influence their opinions and actions. I characterise this function in broadcasting as being broadly educ*ative*. But of course, the ABC also engages extensively in direct educationa*l* activities; specifically, these are the instructional and enrichment programmes, the whole range of output which is aimed at schools and other educational groups by the ABC's Education Department (represented at this Conference by our Director of Education, Mr Frank Watts). I have no special experience or knowledge of this educational broadcasting field, but I commend this area of programming to you as a vital element in your strategy for developing a public awareness of environmental affairs.

Now, to narrow my field down to the basis of what I want to say – where *does* our so-called responsibility lie in the presentation of serious issues to general, adult audiences? I label it "so-called" because I think it is very difficult to define. Maybe my answer, if I have one (I am not sure that I do) will emerge implicitly from what I say; or, maybe at the end, you will brand me as being irresponsible.

I do find that academics misunderstand the nature of "news value" so frequently that I want to reinforce Mr Bennetts' explanation of the vital importance of "newsworthiness". The principles he quoted for deciding on the degree of newsworthiness for the press apply equally as the principal reasons for getting on the air through radio and television. Without news value, we get repetition. Inevitably, repetition leads to boredom; it loses impact; it loses audience.

But for the electronic media, we need to add to those principles outlined by Mr Bennetts, our one extra, but unique and vital, ingredient – what can we see and hear? Or, *whom* can we see and hear? Any story exerts a much stronger claim to time on the air if we can show the action as it is happening and if we can talk with the people who are directly involved. One of the rules-of-thumb of broadcasting is that an issue is hardly worth presenting if people are not prepared to front up to the camera or microphone and present their case succinctly and forcefully. Time on the air is precious and there are plenty of other people and other issues willing to use it. Consequently, we have to be fairly ruthless in rejecting people who waffle. One of the elements of the good waffler is that he talks loosely, with lots of qualifications and "ifs" and "buts" sprinkled all over a very complicated syntax. Regrettably, there are some very good wafflers who are also outstanding scientists – experts whom we would dearly like to have on our programmes, but whom we can't use because they don't present their story well. The press has some advantage over us in that respect; a journalist can "work over" complicated facts or incoherent ideas before presenting them in a clear form for publication.

Another boring characteristic of some stories is that they appear to have a special interest only for the special group to which the presenter himself belongs. For instance, conservation presented principally for the sake of other conservationists would appear too self-interested to carry much weight with the general public.

Another point to realise, perhaps obvious but nonetheless necessary to reinforce here, is that radio and television are very ephemeral media; the message is only there for a second or two before it flashes away. The electronic media are time-dependent operations without any chance for referral back except in the memory of the audience. We would be expecting far too much of our audience if we thought that the details of any individual story stuck in their minds. (This applies to the most sophisticated and educated listeners; after all, I guarantee that few of the delegates here sit in front of the television or the radio set taking detailed notes to which they can refer back later.)

Rather like Dr Mercer's course at Macquarie University, we do entertain *general* aims, in hoping that over a period of time we can pepper in enough news, interviews, documentaries, etc. certain topics which *overall* will generate a feeling about the importance (or otherwise) of this topic. Thereby, we help to form ideas and attitudes; and eventually these may lead to the development of certain values in the minds of the audience. But I do not claim that the electronic media themselves can or should try directly to instil values. For purely editorial reasons too, and writing as a programme producer and interviewer, I believe that people recognise instantly whenever anyone is trying to preach at them over the air; rapid rejection of the speaker's message follows. Therefore, I must agree with the emphasis in Mr Bennetts' paper on the importance of news appearing extensively in *all* its different forms (news items, features, documentaries, personality spots, etc.) if the environmental crisis is to become popularly appreciated and rectified in Australia.

While broadcasters and journalists certainly can "dig" for news, the media themselves cannot really *create* news of any lasting value. Of course, you can fly some sorts of kites in the news media (by, for example, skilfully engineered public relations campaigns), but if they are not buoyed up by a continual strong wind of new and relevant information, these kites will just fall flat. Furthermore, the issue will then be in danger of being discredited in the public mind.

On radio and television, this is most effectively avoided by using people who can answer the following general prescription. These are standard criteria I pose myself and my staff before making a commitment to presenting any item on the air. First, is the person recognised by his fellows as an expert in his own field, or is he a person of public eminence or importance? Secondly, does he have something genuinely new to say or to show? Thirdly, is he willing to get up and say it forcefully? Finally, is he capable of saying it clearly, or entertainingly? Here, perhaps, we can recognise one of our areas of obvious responsibility; the selection of speakers is a delicate business requiring judgement, tact and firmness.

Now, to examine briefly some particular problems about reporting environmental issues on radio and television, as distinct from the press. As I see it, the real trouble facing us is that these issues tend to be rather generalised and broadly conceptual; to us, they are diffuse and fuzzy at the edges. It is often difficult to identify the very heart of the story and to sum it up in the two hundred words, or two minutes on the air, to which any reporter must expect his story to be cut back, simply because there is competition for time with other stories which may have been presented in a more concise, relevant and immediate manner.

Another problem with reporting the environmental situation lies in the difficulty of generating the timeliness or topicality that Mr Bennetts stressed. An example – this Conference is a timely event; it's occurring here and now; and, deservedly, it has already found space in the press. But the topicality of this conference is really artificial. It would not really matter whether it was held this weekend or next except, perhaps, that the competition from other stories for space in the media would be different a week from now. Conferences are useful outlets for you as participants and for us to report what you say. I think that conferences are fairly easy for press reporters to cover (similar to the favourite Australian news techniques of interviewing visiting experts). Conferences present us with pre-digested and well-prepared papers; we know exactly where and when they are happening.

Nevertheless, conferences are limited for the purposes of radio and television coverage; they are often too slow and too sleepy to carry much impact when presented on our media by *direct* reporting of the actual proceedings (i.e. by "live" relays, or replays of pre-recorded and edited highlights). I mention these assessments because I think specialists have over-emphasised the importance of conferences as a vehicle for getting to the media in Australia. Another limitation of conferences lies in the fact that reports from them are removed by at least two stages from the reality of things. You are talking here *about* pollution and population and all these environmental issues, but none of us here is experiencing these problems *at first hand*. Reporting a conference is a remote activity; it lacks involvement. Radio and television, after all, are essentially media which seek to involve the audience directly in a story and in the people concerned. And so, we need to take our cameras and microphones out into the field where the action occurs. I believe it is our responsibility not to squander these opportunities which the media do offer us.

The only sources of information which are really useful for our programmes are what I call "primary sources"; these are found in the specialist journals, or by visiting laboratories, or by talking directly with the people working in the field. Unfortunately, with environmental issues, such primary sources are difficult to identify and to uncover. Admittedly, in Australia we are starting at last to get some hard facts about, for instance, pollution. There are a few enterprising and specialist journalists who are doing very well at this; but I do predict a long road to hoe in Australia on this problem unless we get direct assistance. Therefore, I support Mr Bennetts' advocacy for Dr Boyden's proposal for an "environmental clearing house".

I think this could prove even more valuable for a national broadcasting organisation like ours than it would be for the press, because the press is largely localised. Identifying environmental issues is much easier on a local basis than finding integrated issues which are spread right across the whole nation and relevant to most areas. As Professor Stapp said in his paper, it is the degree of localisation and direct involvement of people in environmental issues which really counts. A Melbourne audience is not really interested in pollution of a river or

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beach in Sydney. Conversely, a discussion about the policy on National Parks in Victoria does not carry much weight with Sydney listeners and viewers. An entire programme about any one of these topics would not therefore have currency across the whole nation, an element which we try to ensure in our nationally-relayed programmes. Without clear identification of national issues, we may simply have to wait for major ecological disasters before we can expect national coverage of this sort, like the oil spillage from the "Oceanic Grandeur" in the Gulf of Carpentaria, or the Crown-of-Thorns starfish menace to the Great Barrier Reef. These have focused national attention on particular problems, but such events cannot be predicted by any but the most acute newsmen. But there must be many really immediate, topical and relevant issues which we don't recognise. We really seek your help in this.

As I see it, the continuing responsibility of the mass media is really a reflection of the degree of responsibility of the community in general, more particularly of the experts and those most vitally concerned with the environmental situation. I am passing the buck back to you. To be effective in the media, i.e. to have potential at least for stories and for programmes, people like the delegates to this Conference need to be prepared to devote time, in between formal events like this one, to ferretting out telling, new information which broadcasters can get their teeth into. Frequently, this also means that the experts need to be willing to spend considerable time and organisational effort away from their research activities in preparing this material in a form which is suitable for presentation on the media. By this I do not necessarily mean that you should just employ public relations consultants, useful though they are for many purposes; to me, too many public relations activities display a degree of implicit self-interest which negates their value.

As a strategy, I suggest a concentration on finding and cataloguing the facts on the Australian environmental situation in the general context of your concern. Informed viewpoints and generalisations will follow naturally from these. Those leaders of opinion who are not naturally good or easy performers do need to develop and practise the skills for presenting their case more effectively on radio and television. Specialists also need to be less concerned about including fine distinctions and qualifications in presenting their cases for public consumption, which they do in the mistaken belief that this will determine how their colleagues will react to the personal publicity which is inevitably generated by appearance on the media. After all, you are talking to the world at large. Finally, I suggest that you should beware of the false adage that any publicity is good publicity; it isn't.

CAN WE TEACH BIOLOGY TO INFANTS? By Earle Hackett*

The recent history of man has seen rapid changes in his applied technologies. His numbers, living standards and his short-term apparent biological security have increased. Nevertheless, biological knowledge applied and extrapolated suggests that he is rapidly approaching a limit situation, and that a fundamental change in his cultural outlook is now needed if his gains in quality of living and survival potential are to be maintained. Insofar as these insights about man's immediate future derive from post-Darwinian biology, then he must rapidly disseminate through his society relevant notions and behaviour patterns derived from this body of knowledge which up to now has not been regarded by him as having vital importance in his general education systems.

Cognitive psychology

Cognitive psychologists have come to realise that the infant period from birth to about five years old is important for the development of curiosity and intelligence. It is also the time when basic social attitudes, patterns of thinking, and behaviour habits related to community health seem to be received into the personality. At any rate, the remainder of a human life is strongly affected by "education" (I suppose we can call it that) received at this time from parents, siblings, teachers and the surrounding community.

Now, educationalists are at present interested in this period of life so that they can improve the performance of the brain as an organ for school and university achievement, and later for the complex operations of applied technology. Logical, mathematical and associated creative skills are stressed. Much of the work which has been done has been among retarded children, this being an area where research funds are readily available.

Adult World-views

But from the point of view of influencing later adult behaviour, psychobiological techniques applied to the very young are looked at askance. What? Condition our children as in "Brave New World"? No, the infant must be free to develop an inner life of private individuality – one must try merely to increase his/her facility for learning and expression so that *later* a wide choice of options

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becomes possible for him/her. This is a permissiveness which has become an important component of our present culture, and I agree with it *as a component* because it ensures that new ideas will continually operate within any contemporary idea-system, and I believe that diversity in this area is an important factor in the adaptability and therefore in the survival of our species. But I must point out that, at the very same infant period, parents and community educators are already training (i.e. conditioning) the infant in eating habits, in the disposal of excreta, in body cleaning techniques, and in attitudes to others. And these parents and teachers support what they are doing with whatever imperatives or explanations relate to their adult world-view, whether deduced or intuitional, of *why* these behaviour patterns are necessary.

Pass the sauce, John.

Pass the sauce, John, please.

Pass the sauce, John, damn you.

Pass the sauce, John, like Mummy's good little boy.

Pass the sauce, John, if you're sure you've quite finished helping yourself.

Pass the sauce, John; Granny loves it.

Pass the sauce, John, because food sharing habits that avoid waste and needless aggressive fighting are vital to the survival of our community with its limited resources.

Pass the sauce, John, because without it I can summon no gastric juice to this 100 gms of tasteless mock meat supplied monthly to each of the twenty million people who now live where your great-grandfather and his wife and three children once kept their herds.

Let us get back to the fact that many mathematical, reading and language skills can now be taught much earlier in life than was heretofore supposed. Some very junior classes in these areas of experimental infant education have included "science" subjects. At present these classes are most highly developed in the fields of the physical sciences. Difficulties seem to be encountered in the teaching of biology. This is because it is regarded as a complex subject depending on physical and chemical notions which must be inculcated first. So now I should say what *I* mean by biology.

The New Biology

When Shakespeare wrote his plays, the view he took of the world of man and animals was about two thousand years old or more and widespread in Western culture. It was much the same as that of Moses, Aristotle and Galen. Shakespeare's biological outlook was part of his total outlook – he certainly didn't think of it as a separate "subject". He believed in the universal harmonies that were supposed to find echoes in the body and personality of a man, in the elements of which the world was made, and in the music of the heavenly spheres. For example, in his day

people were bled and purged according to astrological indications.

Again, in the 16th century everyone "knew" that the liver was the source of the blood. Blood was the courageous humour. Consequently cowards were lily-livered. So when Shakespeare described someone as lily-livered, he could rely on his hearers being familiar with the biological presumptions which were part of the total culture. In large numbers, they behaved consistently according to their theories of life, and they knew exactly what he meant.

But also in Shakespeare's time, the doctrines of Copernicus, Kepler and Galileo were changing man's notions about the solar system, and soon after Shakespeare came William Harvey who discovered the circulation of the blood. That was the kick-off point for the new biology.

Today, we still regard man as being linked to the systems of the surrounding universe, but not by humours, elements, or the music of the spheres – it is by his material structure being composed of the same fundamental particles as the non-human surroundings, and therefore subject to the same physical and chemical laws. But we believe that the kind of biological knowledge developed by men like Harvey and Darwin and Pasteur and Mendel and Freud represents a truer view of the nature of man and his environment than the biologies of Moses, Aristotle and Galen. Nevertheless this "new biology" is still only a "subject" so far as our educational system is concerned. There is a cultural lag. It takes generations for education to affect conduct. Probably the majority of people are still running their lives according to the old Moses-Aristotle-Galen system.

Survival Information

But I believe that parts of the new biology, and some of the imperatives that flow from it, amount to survival information for our species at the present time. I want our species to survive. I do not question this "want" because I can see that as an evolute, an animal which has evolved, I am almost certain to "want" in this way – no other attitude could have been generally selected and programmed into me by nature. This insight in no way weakens my drive towards survival, nor does it fill me with intellectual despair.

If, then, modern biological knowledge is important for survival it should be taught at the most basic level. The most basic level, I suggest, is the infant level. Therefore the relevant principles of the new biology should be taught to infants. Only the relevant principles. Not all the detail. Not necessarily the Krebs Cycle, or the mouth parts of the cockroach, or the order of the cranial nerves of a vertebrate. Perhaps not even the cell. I repeat, I'm not thinking of biology as a "Subject" in the usual school sense – not like Physics or Chemistry or Science or English or Maths – even the great New Maths. I'm thinking of biology more as the rational basis for self-conscious human behaviour, the Great Propaedeutic – what you learn before you learn anything else, because it is more general for humanity than any of those

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others and if your community doesn't take it as the foundation of their world-view and act on it your group won't survive at a level at which it can learn sets and vectors and radio-astronomy and Mandarin Chinese, not to mention gourmet cooking, and interior decoration of the cages of what Desmond Morris calls the Human Zoo.

I am therefore looking at biology as a set of insights into a set of constraints on life. These constraints apply to man as a species included in the biological system. If man can make his culture aware of these constraints by rational means he may adapt to them with less distress and more promptly than if he uses the alternative more old-fashioned irrational methods of adapting to one's environment.

Ways of Adapting

By these I mean (1) taking up arbitrary models of the human biological situation, intuitively produced by seers and mystics without logical examination or experimental verification, and living them out at random until the most suitable is selected by the environment – time required for each new feature of the model to be determined and applied: 100 to 1,000 years. I think some of the younger generation are moving into this form at present. (2) Waiting for the non-conscious genetic process to select a set of automatic mid-brain and brain-stem responses as in the non-human vertebrates – time required for each new stage in an animal with as long a generation-time as man: 10,000 to 1,000,000 years.

Both of these are too slow acting to modify the accelerating and irreversible effects of our having entered the recent technological psycho-social phase of our evolution. Therefore the solution will itself have to be pyscho-social and perhaps technological. But, having "discovered" how to "discover", now we have "discovered" that some problems are soluble only by changes in human behaviour patterns, which are not exactly technological solutions. Nevertheless, I advocate the acceptance of the scientific view of the biological nature of man, and the merging of it rapidly into our total culture by teaching it to our infants, hoping this will modify human behaviour patterns.

The Infant Intellect

Now, let us ask again, "What is biology from the point of view of Teaching it to the Littlies?" Again, it's *not* the academic subject known as Biology. Academic subjects are rational constructs, each based on a particular set of axioms. Before you can learn academic Electro-Magnetism or academic Geography or academic French you have to learn their given statements and their rules. These then build up into concepts of increasing difficulty, until, at their most developed levels, there is no hope of teaching them to anyone who has not already had ten or fifteen years of practice at this sort of thing. Admittedly, there are certain concepts which, while part of advanced subjects, have nevertheless a simple analogous form which can be

displayed as two or three dimensional models. Thus little children can be taught aspects of mathematics or chemistry or physics, but only selected parts. Not all the biology we would want to teach infants, from the point of view I have been adumbrating, is reducible in this way. So what can we expect them to learn, and what bits of biology do we want to teach?

We had better look now at what is known about the infant's intellect. The Swiss psychologist, Jean Piaget, is the authority on whom most educationalists rely for a description of the stages through which a child's intellectual capacity passes.

The Piaget Stages

The School of Piaget holds, as a generalisation, that the normal child's intellect passes through a succession of stages. The sequence of these stages is always the same, though the time taken to pass from one to the next may vary considerably from child to child, from culture to culture, and from race to race. There is an inherited component in the rate of transition, and the quality and intensity of the child's interaction with the environment play important parts in speeding up or slowing down the transition from stage to stage. The stages are *very* roughly (it is almost dangerous to give arbitrary ages at which the transitions may take place) 0-2 years, sensorimotor pre-verbal stage; 2-4 years, pre-operational intuitive stage; 4-10 years, operational stage; 10-15 years, hypothetico-deductive stage during which logico-mathematical skills can be fully developed. These stages do not supplant one another, they are simply the phases in which new mental processes become possible for the individual. But a logico-mathematical adult can retain access to his pre-operational childish thought forms – for example, Lewis Carroll. On the other hand, the kind of training given a budding scientist may so cultivate his logico-mathematical faculties that his pre-operational inductive poetic way of thinking may be crowded out and quite superseded. At this point, I would like to mention a general book which I, as a non-teacher, non-psychologist, have found very helpful. This is "Revolution in Learning – the years from birth to five" by Maya Pines (The Penguin Press, London, 1969). Miss Pines claims that what Freud has done for our understanding of the growth of the emotions, Piaget has done for our understanding of the growth of the intellect, showing the stages by which an infant organises information in his/her head and continually modifies his/her mental constructs to conform with outer reality.

Round about the age of two, anyway, at the end of what Piaget calls the sensorimotor period, there is the take-off period for abstract thought. The child can then make mental combinations of ideas, using a repertoire of words, images and experiences. This does not mean the child is capable of conceptual thought; that comes later, in the operational stage, at four or five. But during the time from two to four, say, (and this cannot be taken as an arbitrary period applying to *all* children) the child can use symbols and names with increasing facility and intuition.

It is partly a time of fantasy, but it's also the "What's that?" stage. The child has a wish or drive to know the names of things and a growing wish or drive to know what class of things each one belongs to. His/her attention can for instance be directed by a teacher to some particular aspect of a number of things which enables them to be grouped or collected, but although he/she can therefore learn crudely to "classify" at this early age, he/she cannot "operate" higher classifications, he/she cannot reason in the adult way, but he/she can think intuitively, if not logically. Piaget says the child at this stage is thinking "without the reversible nestings of a hierarchy of classes and relations". There is no internal conservation of strictness of definition, so it is not surprising that this is the time of fantasy, when mental symbols swell and dwindle and change their relationships, so that, for example, it is not possible to have consistent notions of classes of objects which are sub-classes of other classes, the sort of construct on which the operations of logic, mathematics, geometry and physics are based.

Learning Names

However, the more names and symbols and crude collections a child accumulates in his/her two to four years old, pre-operational intuitive period, the more he/she will have to operate on when he/she does reach the next or operational stage, but, also, the more quickly will he/she reach that next stage. It seems not to be decided whether an infant's growing ability to think in the two to four year old stage depends on forming mental images of things handled (or seen or smelt or sucked, etc.), or whether knowing names for them is essential for thinking because it identifies them linguistically. At any rate, verbalising is very important, if not absolutely essential to mental development. For example, with children of one to two-and-a-half in Russia, those who were told the name of the colour red learned to find sweets under a red cover more easily than those who had no name for it. They also learned almost immediately to transpose the experience to other finding-under-red situations, while others could not, and they remembered what they had learned for a longer period (quoted in Pines). It might have been better to use green as a control, and then to repeat the whole experiment with Irish children.

Similarly, knowing names for other visual experiences like "spot", "stripe" or "net" enables a more quickly learned recognition and matching of these patterns, compared to the learning rate of a control group of infants who were taught to match without being given names for the patterns.

Hidden Curriculum

All right. Names are in. Simple classifications and collections are in. Didactic explanations are in. Hey, who said that? Won't didactic teaching stunt or over-train the private individuality of the child? Here we go again. Come off it! – there's hidden curriculum in language, and in practically everything we do in a family. I

refer you back to the various ways of asking for the sauce. And there's pot training; there's all the warnings given by mothers – those great programmers of educational input. There's "manners". Hell! – how do we transmit the presumptions of our general culture? – we bring up *humans*, don't we, not *random intellects*? I don't see how we can avoid at least some dictatorial teaching at mother's knee. Who tells them which berries are poisonous? Who conditions them to the belief that fires burn, knives cut, and motor cars knock down? I say that didactic biological explanation is basic information for survival. It is not, I repeat again, part of a training in a specific "subject". And if you don't "like" the idea of early didactic teaching in aspects of biology because this may not leave the child with a "free individual personality", I can reply with a similar emotionally-loaded oblique argument. I will say that early general training in logico-deductive skills which enable children to move quickly into Physics and Chemistry and Mathematics as "subjects", if given without firm biological guidelines, is simply the training of science-oriented factory technicians and blind consumers for the commercial – acquisitive – obsolescence – hire-purchase – shortsighted salesman's society which is rapidly over-populating and polluting and destroying its own habitat.

Living and Not

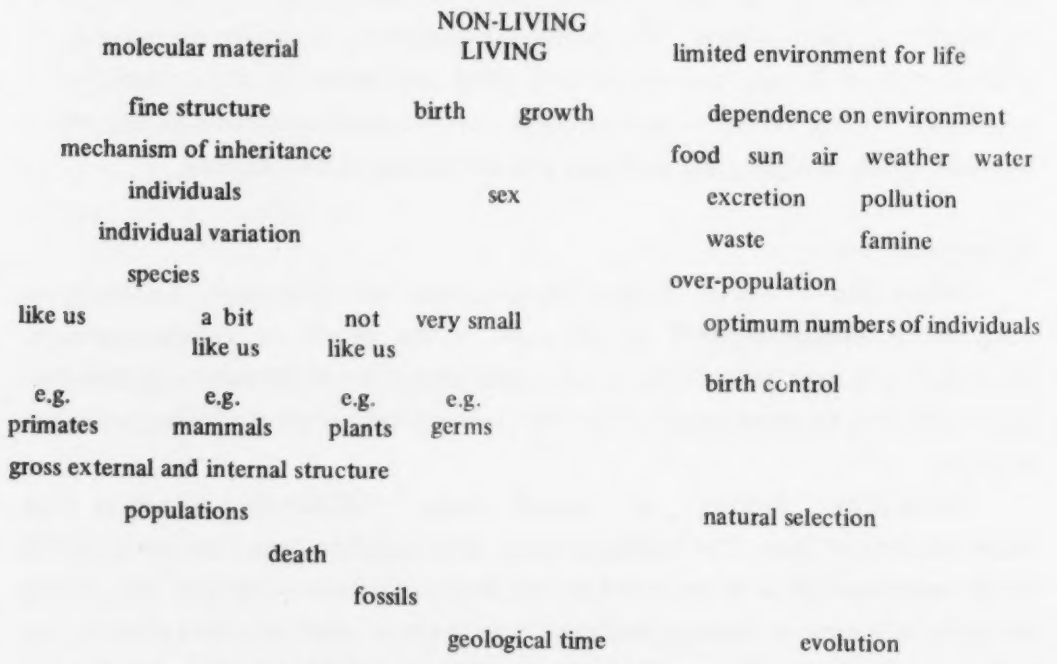
Where was I? Names. Simple classifications and collections. Explanations using words already adopted by the mind of the infant, or understandable as extensions of known words. The use of simple objects for constructs or models that can be handled by small people. Now with that we must teach the biology we want to teach.

Descriptive "biology" or "nature study" traditionally comprises vast accumulations of facts. The biological scene is all variation, and, historically, much of the variation had to be described before the generalisations emerged. But, having emerged, it is some of these generalisations we want to teach, not the variation. For instance, a fundamental piece of life lore I would like the littlies to know is that life is mechanism, not magic, and cannot transcend the material universe in which it finds itself. This derives from the fact that while there is a difference between living and non-living, nevertheless both non-living and living are made up of the same molecular components – the same material stuff. Now, straight away, you will see that here we have the sort of thing that Piaget says the mind of an average child of this age cannot readily "conserve" in the reasoning process, and so the deductive part of it may not be teachable.

So all we can do is seek to provide a linguistic statement of the components of this idea, and of others, and leave them disconnected in the child's mental pool of intuitions until he/she reaches the next stage, of operational thinking, when we may hope that, still under guidance, the connections will be made.

Life Lore for Littlies

Here is a page of notes I made when considering what biological notions should be part of the general culture, and which I would therefore recommend as suitable insertions into the child mind at the mother's knee or two-to-four stage, if this is possible. Let us take again the separation of living and non-living, and consider how it can become part of a sorting session. Sorting is a skill very commonly taught in infant schools. Objects can be separated according to colour, size, texture, etc., but one could regularly return to the question of whether the objects are living material or not. It is essential, of course, that the children soon know the meaning of "not". The teacher could reiterate that, although some objects are difficult to classify, all can be finally accorded to one category or the other.



Now, although I think this distinction between living and non-living is very important, even fundamental, this doesn't mean it would have to be introduced first in the infant curriculum. Similarly, although evolution is the most comprehensively integrating biological idea that man has ever had, it would be near impossible, I think, to teach it in the pre-operational stage. In this phase of the developing human intellect there is no need for a teacher to move along the logical stages of a subject, and therefore it is not essential to start with one notion rather than another. At first all notions are equal. All are given. None are derivative. Teaching them will depend more on whether they can be linked with some notion the infant already has. Apart from anything else, the faculties of infant pupils will vary, partly because of conditioning by parents, partly because of variations in genetic inheritance, so that some will already be excelling as visualisers, some will be auditory types, some verbalisers, full of words, and some will be skilled

manipulators of objects. Innate skills and receptivities will be unequal.

Teaching Methods

Therefore it becomes a matter of a teacher/parent picking and choosing the naming exercises, educational toys, participatory games, or direct experiences of objects, as they seem appropriate to the notion being taught in the particular relationship between teacher/parent and each pupil/child.

To take another example, growth is an important biological generalisation, and so is birth. The germinating seed, the hatching egg, the suckling mouse or guinea pig. These are well known kindergarten "enrichment" items, but are also available to many home environments. At episodes of naming or question-answering and observing, the fact that non-living matter does not give birth or grow can be stressed.

The range of species is something that can be demonstrated to most infants during nature walks or visits to zoos, or by films or pictures, and is another important fundamental notion. There are, I suppose, a few large built-up cities today where children cannot be shown some range of living things, but this is mercifully still unusual and, in naming species, the teacher/parent can say whether the living thing named is "like us" (chimpanzees, monkeys, baboons), "a bit like us" (all other backboned animals), "unlike us" (arthropods, molluscs, green plants, fungi), or "very small" (germs, yeasts). This is of course another kind of collecting and classification. The teaching points involved here are that man is an animal and that the range of living things extends down to the microscopic. This last would not be understood in a very real sense, but using a large magnifying glass would eventually help to instil the idea of life and structure extending below the level of ordinary visibility, and some young minds will grasp this with strong intuition.

The biological principle of individual variation could be taught by encouraging children to classify themselves by physical appearance. As far as school classes are concerned, I would think that this should be done with pupils in the nude on convenient occasions, particularly as families are likely to be smaller in future with therefore less likelihood that young children will be familiar with the differences to be seen when the sex organs of themselves and their contemporaries are compared in a family context. Sex is the fundamental variation between individual humans. Eye, skin and hair colour are others to which attention could be drawn, stressing regularly that *every* human is one of "our" species, one of the gang, part of the group, not to be disliked or hated or fought.

Leaving the Ground

I have already said that it is essential that the child knows the meaning of "not". It is also essential that he/she be trained as soon as possible in the meaning of words like "or", and comparative phrases like "enough", "too much" and "too

little". There is no need to go into the methods of early training in linguistic skills – these are becoming well known – but they are important for the implanting of these biological notions which have to do with dependence on environment – that sunlight, green plants, air, water and soil must be kept in good supply and unpolluted. That "too many" people will cause the supply to fail, and the earth's living space to be spoiled. Therefore, we must not have too many people, and so we need the idea that parents have children, not inevitably, but as they arrange.

Now, you realise I'm sure, that so far as the pre-operational two-to-fours are concerned, we have left the ground a few sentences back. You may indeed be able to teach apparently advanced reading and mathematics of a kind by this age, using persuasive and "catch-their-interest" methods, but is there any real hope of installing all of these various socio-biological notions by such methods before the age at which personality becomes relatively fixed and after which changes in life-attitude are most difficult to bring about?

The Talking Typewriter

A "catch-their-interest" persuasive technique of a modern technological kind is exemplified by the use of the talking typewriter. By its use, reading and writing skills are built up in the individual child using his/her natural inquisitiveness. In principle, the child takes the initiatives and "teaches himself/herself" in his/her "own way". Pleasing an adult, or achieving anything immediately such as a "correct answer", is not part of the method. Everything the child does on this machine results in a response, either by a listening unseen teacher, or by the writing-speaking-displaying computerised non-jamming typewriter itself, and the child enjoys this expanding interactivity with the human communication system of sounds, letters and words, and progresses rapidly in it. I can see how this method takes children into reading, writing, poetry and literature by the ages of four, five, six and seven, but these are ages when basic socio-biological attitudes have *already* been programmed into them by adults. And so I don't see how any modifications of the persuasive self-responding "draw-them-on" technique can teach my kind of biology.

Rote Learning

So, is there any other way? Yes, there's rote learning. At an early stage of preparing this talk, I re-styled some nursery rhymes. As they turned out they are completely unsuitable for teaching infants. They have too many complex words in them which the infants wouldn't relate to anything real, and which would only encourage them to fantasticate in an area where there is already enough fantasy, culturally speaking. I had forgotten that our so-called "nursery rhymes" are, variously, relics of religions, anachronistic references to long-dead political issues, and misrepresentations of forgotten dialects or foreign languages. And this sort of

parody only catches the interest if the original is already well-known. For example:

Jack and Jill
Went up the hill
For water, so they mooted,
Because low down
Around the town
It's usually polluted.

See-saw, Margery Daw,
Jenny's employed as a blaster,
She's destroyed a park, and a bay,
And a mountain of pure alabaster.

Fossils are dead,
Bid them adieu.
Living is sweet,
And so are you.

Little Bo-peep
Has found a heap
Of genes and she can't unwind them.
Lay them aside
And they'll divide,
Wagging their tails behind them.

Humpty Dumpty sat on a wall.
Humpty Dumpty had a great fall.
It's the same for an egg as for egg-shell ceramics –
You can't beat the Second Law of Thermodynamics.

Three Dichotomies

Let us get back to the point where we were considering firm didactic rote-teaching, as opposed to gentle persuasive catch-their-interest teaching. And I think they are often "opposed". Teachers who use one or the other tend to be opposed. The *two* methods seem to involve different political and social philosophies, as different, and as partisan and emotion-rousing as the way of Hitler and the way of Gandhi. But perhaps each has its place.

We can accept from Piaget that there are these *two* phases of mental development that merge from one to the other in the infant to child period – the pre-operational and the operational. Very roughly, as I say, the first lasts from 2-4 years, and the second from 4-10. (Remember, the first Piaget period from 0-2 years is the sensorimotor pre-verbal time which you could not use to teach biology though in it you could greatly influence certain personality traits, such as aggressiveness to strangers and reverence for living things. The fourth Piaget period from 10-15 covers the development of the final adult hypothetico-deductive stage.)

Let us also come back again to the *two* different educational objectives that we have been referring to. First, there is training in the ground-rules of convention and behaviour which integrate the individual as early as possible into the cultural ways of the group. Typical objectives of such training are, as I've already mentioned, the disposal of excreta, the development of eating habits and of aggression-controlling rituals for greeting and conversing with others. Second, there is training in the logical-mathematical-associative-language skills, the development of which is usually called "intelligence". These skills are the basis of our technologies and are at present in great demand. Now, dichotomies are perhaps dangerous, being so easy to handle, but we have three dichotomies here.

Teaching methods	*Piaget stages*	*Educational objectives*
1. Didactic rote-teaching	1. Pre-operational	1. Socio-biological ground rules.
2. Persuasive catch-their-interest teaching	2. Operational	2. Intelligence skills.

Now it seems to me that they fall readily into this one-two grouping. The first of each pair phases into the second. And all the first stages go together in time, for it is a matter of observation that the existing conventional socio-biological ground-rules are taught didactically, that is without real "explanation", at the pre-operational stage. Taught by whom? Mainly by parents, and particularly by mothers, those great programmers of basic educational input. Could anyone else do it?

Nursery-mat

Well, imagine a group of 5 children, aged 3, attending a one-hour teaching nursery-mat while their mothers stay in another room with their other children where they can have coffee or talk. With new shifts every hour six adult teachers could handle over a hundred children a day. A nursery-mat is as accessible and informal as a neighbourhood laundromat. The name was invented by Nancy Rambusch of New York. You should be able to do any kind of teaching in a nursery-mat. Sergeant-major stuff or talking typewriters as you please, or as you have the money. A one-hour attendance is not complicated by toileting, juice, biscuits, sleep-time, outdoor play or making Christmas stockings – it all goes on teaching.

Well – it's Biology Day. The children are shown a kitten, a brick, a growing plant, a stone, a blown-up balloon, a metal spoon, a sprouting potato and a small moving beetle (or worm, or snail, or mouse, or fish). The teacher names these eight objects in turn.

This is a kitten. Say it all together. Kitten. Say it, Billy. Say it, Susan. Kitten. This is a kitten. Now listen carefully. Is this a kitten? Yes, this is a kitten. Now, what is it? Kitten? Say it all; give me the whole sentence. Yes, this is a kitten. Say it louder. *Yes, this is a kitten*. Now clap your hands as you say it. *Yes - this - is - a - kit-ten.* You *are* good. You *are* working hard. Now, this is a balloon. Now, let's say it together. This is a *balloon* .... and so on. Then after a few days. What is *this*? *This* is a kitten. *This* is a flower. *This* is a potato. *This* is a snail. Very good, you *are* working hard. Now listen carefully. These things are *alive*. Say it all together, *alive*. *These - things - are - a - live*. Let's give them a cheer! These things are *alive*. Hurray! Let's make up a song about them and clap our hands. And so on. Other things are *not* alive. This sort of biology teaching would be like much traditional home and kindergarten teaching-play between adults and infants, that is, very physical, often rhythmical, lots of concrete objects, much clapping of hands and arm movements and repeating things, maybe music; rather noisy. What this technique is used to

teach in the home or amongst children themselves is some game or song, in fact something "recreational", the object of which is group solidarity or physical play rather than formal education. But even there it probably has much hidden curriculum in it, teaching social practices or presumptions of the group. So why not use such a technique for teaching this kind of biology? If it is effective and if this biology is important, what other criteria matter? Other things can be taught in other ways, and such sessions could be alternated with environment-responsive teaching.

So, can it be done?

So now let us ask again. Can we teach biology to infants? And the answer seems to be: Yes, mothers can. And how does a mother avoid stunting a child's individual personality by over-training it? The simple answer is: By doing it with love. Love includes some permissiveness. Love for their children comes naturally to most mothers. And to the question: Can special teachers help mothers to teach biology to infants? – the answer is probably again: Yes, by taking small groups of children for about an hour a day.

From where do we get the infants teachers versed in biology and other things? From the same sources as we get other teachers – from training colleges and universities – but we must pay them and all teachers just as much as we pay those who instruct at the tertiary levels. All teaching is important, but we need as high or higher teaching skills and energy at the infant level as at the primary, secondary and tertiary levels.

And how do we teach mothers biology? By teaching everyone biology (in the sense in which I am using the term here) – by making it part of the universal culture, by drawing constant attention to the inescapable biological components in practically every decision we take, even by bits of propaganda like writing parodies of nursery rhymes. That's why I left them in.

Now I may be absolutely wrong about the techniques of positively teaching infants the important biological generalisations and the life-styles that derive from them. But I feel I am absolutely right about the necessity to teach them at an early age. Maybe such teaching cannot override the genetically determined behaviour patterns which, for all I know, have been programmed into most of us by the evolutionary experience of our species. Perhaps over-population, and despoliation and pollution of our environment are written by DNA into so many brain stems that the cortices above them can only be carried kicking and screaming to disaster. It may be so. But it is also part of the human presumption that it may *not* be so. And so, even if the only message I leave you with is that educationalists and cognitive psychologists should look at the whole question of training infants in biology, then I am satisfied. They may find that what is required is not the nursery-mat, but a change in our whole system of child rearing so that the family

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becomes an extended group of fifty or a hundred cousins, uncles, aunts, grand parents. Or they may find a way of programming a talking typewriter so that it can teach absolute lasting loyalty to the biological ethics of a group.

Is there time?

And to the final question: Is the injection of modern biological knowledge into the culture, or any other educational solution, likely to be achieved in time to alter (*if it can*) the life habits and attitudes of the whole human species and therefore to save it from the disasters of over-population, pollution, nuclear war and the rest? The answer is a sad one. Probably not. Though you never know.

But cheer up, scientific ideas and biologists at present have world-wide mobility, even though not all of them pursue or embody socio-biological survival policies. And even if our species takes a bit of a thrashing, it is unlikely to die out finally for hundreds of thousands of years anyway. Other times, other chances. Some of the new human life styles of the past were not completely successful in world terms, but some of their teaching has come down to us over gaps of one, two, three thousand years. So we have been able to gauge those styles, and their effects. Experience counts. And today there is printing, and there are libraries. If we record what we're thinking, and doing, even too late to save our contemporary selves, some day another lot will have another go – in time. Long live *Homo sapiens*!

(I wish to acknowledge the help I received from two long conversations, one with Miss B. Davis, Principal of the Kindergarten Teachers' College, Adelaide, and the other with Dr A.N. Broadhurst and Mrs L. Penny of the Bedford Park Teachers' College, South Australia.)

REPORT OF THE WORKING GROUP ON "ENVIRONMENTAL EDUCATION IN THE SCHOOLS". By Gavin N. Seagrim, Chairman*

Three motions were passed by this working group, as follows:

1. That the Australian Academy of Science be asked to set up a committee, or to ask one of its existing committees to concern itself actively with the question of environmental education for school children of all ages, and that the following statements be placed before this committee for its consideration:

   a. At this stage we feel that it would not be in our best interests to give separate representation on curricula to environmental education.

   b. On the other hand, steps should be taken to prepare, or to contract to have prepared, new texts and resource material to be used in the teaching of science at all appropriate levels, which texts and resource material should stress the integrating theme of the relation of human beings to their environment.

   c. Bearing in mind that the teacher is the most important single factor in the situation, steps should be taken to go into the problem of how teachers can be trained to handle this subject. In particular, in-service training should be actively undertaken, great efforts being made to reach all teachers (and not at their expense).

   d. Advice of expert consultants should be sought in all aspects of this work.

   e. Any steps taken should be co-ordinated with those taken by the Australian Academy of Science School Biology Project, by the Australian Conservation Foundation and by other appropriate bodies.

   f. Steps should be taken to seek the assistance of, and the influence of administrators generally and, in particular, of Ministers and Directors-General of Education, School Inspectors, Headmasters and Headmistresses.

   g. Steps should be taken to set up, or to have set up a clearing house of information on the environmental situation. The material thus collected should be freely available to all teachers and to others concerned with the education of children.

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2. That every infants, primary and secondary school syllabus should contain a formal statement advising that all subjects should be presented with reference to the quality of the human environment.
3. That the President of the Australian Academy of Science should approach all Ministers and Directors-General of Education about strengthening (in N.S.W. and W.A.) or setting up (in the remaining States) units of conservation advisory staff within their Departments of Education to assist teachers.

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REPORT OF THE WORKING GROUP ON "ENVIRONMENTAL EDUCATION IN THE COMMUNITY". By Donald Walker, Chairman*

In considering the environmental education of the "community at large", the Conference had in mind not only the collection and dissemination of appropriate information but also the need to arouse public concern and to provide avenues for informed action.

The following were proposed by this working group as possibly desirable means of obtaining facts in ways which could be given meaning for the general public:

1. Information centres, Commonwealth and State,
2. Royal Commissions or parliamentary committees on particular issues, and
3. A permanent Royal Commission on the human environment (as established in U.K.).

It was thought that the mass communications media should be encouraged to give greater effect to environmental education by:

1. Increasing the number, length and scope of citizen participation programmes (e.g. radio phone-in programmes),
2. Increased monitoring of appropriate overseas information,
3. Selecting better times for radio and television programmes on environmental problems,
4. Providing continuing reportage of long-term issues, and
5. Stressing the relevance of environmental issues to the individual and the local community.

Increased efforts should be made to enable museums, national parks, art galleries, biological centres, field studies centres and other similar organisations to expand their educational activities in the field of man's relations with his environment. Assistance should also be organised for citizens' associations and service clubs to enable them to carry out educational programmes, and take action on specific local issues. The possibility of setting up citizens' committees specifically to recognise and expose issues of environmental importance should be explored.

In order to give general direction and thrust to these developments, the Academy should identify and publicise the most serious environmental issues likely

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to afflict Australia during the next five years (e.g. problems of city transportation, resource development, the Great Barrier Reef). A similar function could be served by recruiting speakers from Australia and overseas to address national and local groups on aspects of the environmental crisis and by publishing a magazine devoted to this and related matters.

Finally, there is a need for research on information movement through those parts of the community no longer subject to formal education so that concern, protest and action can be developed on as broad a base as possible.

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REPORT OF THE WORKING GROUP ON "ENVIRONMENTAL EDUCATION AT THE TERTIARY LEVEL". By Bryan Furnass, Chairman*

Aims of Environmental Education

It was agreed that environmental education at the tertiary level should have four main aims:

1. To create awareness and stimulate thinking and concern about the environmental crisis amongst university administrators, academic staff and students, both in regard to the global situation and the local Australian scene.
2. To disseminate knowledge about man and his environment, and to conduct research into aspects of this relationship, in order to create an informed community. Only then will the action required to correct and avoid abuses of the environment be taken with the best judgment.
3. To help prevent further deterioration of the human environment from physico-chemical pollution and unrestricted or inadequately planned development in urban and rural areas.
4. To promote improvement in the quality of the environment and hence in the quality of human life.

Present Situation and its Deficiencies

1. *Courses Available* – Environmental aspects of the human situation were incorporated, in most cases only recently, into syllabuses on Human Biology in the Universities of Western Australia, Melbourne, Monash, Macquarie and the Australian National University. The course in Biological Resource Management at the Canberra College of Advanced Education was cited as an example of a course of study in the needs for conservation, recreation and the control of pollution. The same College is currently discussing an integrated approach to architecture, landscape gardening and interior industrial design, and has planned a course in human ecology, available to all disciplines. In the University of New England, a new Department of Natural Resources has been established. At one Victorian Teachers' College (Bendigo), seminars on global

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This group discussed the environmental education of non-environmental students at Universities, Colleges of Advanced Education and Teachers' Training Colleges.

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problems posed by the environmental crisis have recently been instituted in the third year of the training schedule.

Despite these innovations, courses referring to the environmental crisis were estimated to reach less than one per cent of tertiary level students in any institution. The meeting felt that this proportion was quite inadequate, considering the extent and urgency of the problem.

(A continuing education course on the Biology of Urban Man at the Australian National University and a similar programme in Melbourne were quoted as examples of attempts to create interest in the environmental crisis amongst the general public.)

2. *Lack of awareness and concern* – The group believed that there was a lack of awareness amongst the academic community about the environmental hazards facing our society. This deficiency was often more apparent amongst staff members, including biologists, than amongst older students. The meeting felt that there may be two reasons for this – firstly, that the specialised nature of many modern academic disciplines tends to inhibit thinking on broader issues and, secondly, that environmental change in Australia has not yet interfered with the quality of life to the same extent that it has in many parts of the United States of America. Nevertheless, the view was unanimous that the prevention of serious decline in environmental standards was likely to prove much less costly in the long run, in both human and economic terms, than any subsequently attempted cure.

An opinion was expressed in the working group that an exclusively biological approach to the environmental crisis provided too narrow a viewpoint. In the modern urbanised state of Western man, the creation of ugliness should be considered as a major issue in the environmental crisis. The solution of such problems lies in the hands not only of biologists but also of architects and landscape gardeners, working with town planners to create aesthetically appealing surroundings.

It was generally felt that co-operation between the Natural Sciences and the Humanities was not only possible but essential if the positive aims of environmental quality were to be achieved.

By the same token, it was appreciated that a full understanding of the environmental situation cannot properly exclude the social and psychological stresses caused by crowding, surburban isolation and loneliness, particularly amongst migrant populations, or the problems of drug abuse and excessive alcohol consumption which constitute disturbing features of modern Western civilisation.

3. *Lack of communication* – The working group was concerned by the lack of communication on current and prospective environmental problems between students and staff members, between faculties, between universities and

colleges and between tertiary institutions as a whole and the non-academic community. The latter deficiency was considered to be particularly serious in view of the widespread and sometimes irreversible impact on the environment brought about by civil and mining engineering, manufacturing industries, town planning authorities and city councils. A good level of communication does, however, exist between industry and Colleges of Advanced Education, whose courses are specifically tailored to meet community needs.

4. *Lack of money, time and teachers* – Apart from the small number of academic staff running the courses mentioned above, no money was presently available from tertiary institutions for teaching or research on the environmental crisis, either for staff salaries, payment of visiting lecturers, laboratory facilities or film-making programmes which could be used as aids to the educational process.

   Many senior students in universities and colleges feel deeply concerned about current environmental issues but, in view of the increasingly crowded and competitive academic courses, can find little time for serious study, debate or field work on the environmental crisis as extra-curricular activities. The group felt that a good deal of frustration was created amongst young people by the apparent irrelevance of much of their academic work to the human situation and that, in many cases, they would welcome more opportunities to relate their particular discipline to the environmental crisis. Lack of resources for tertiary education in the urgent problems facing man could only lead to an increase in public apathy and to a compounding of the damage being done to our environment.

Media and Mechanisms of Education

Education on environmental issues in universities and colleges was considered from the short, medium and long-term points of view:

1. *Short-term planning* – Education of the educators was seen as the first essential step. Knowledge of the existence of a crisis and the need for urgent action to meet it could be achieved through extra-curricular seminars of an inter-disciplinary nature, preferably including the presentation of results of local field studies undertaken by students in the biological or social sciences. The value of these informal meetings would be enhanced by an exchange of views with industrialists and town planners; and their appeal would be greater if they covered not only the negative aspects of the environmental crisis, such as pollution, but also the positive aspects of environmental quality such as architectural design and the provision of recreational needs.

   The working party recommended that universities and colleges should co-operate with the Australian Conservation Foundation and with local industries in establishing Field Studies Centres in both rural and urban areas.

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Such centres could constitute valuable bases for education and research at the secondary and tertiary levels, and could also provide clearing houses for information on environmental issues with the community at large. Facilities of this type have proved their educational worth in the United Kingdom.

2. *Medium-term planning* – The working party believed that concepts of man and his environment should be introduced to children not only in primary and secondary schools but also at the pre-school level, where receptivity for information is at its highest. Implementation of this type of education calls for the inclusion of a course on environmental science in all teacher training colleges, combined with an in-service training programme for qualified teachers.

   It was pointed out that, if evidence of basic knowledge about man and his environment became a prerequisite for admission to universities and colleges, then this would provide a major incentive for the inclusion of such studies in the school curriculum. Subsequent teaching to a large number of diversely orientated students would be made more feasible if students in say, Law, Economics, Engineering and Town Planning had some biological background and, conversely, if students in the physical and biological sciences had prior knowledge of the impact of science and technology on man's situation.

3. *Long-term planning* – Recognising that the environmental crisis would affect people in all walks of life for many decades to come, the working party considered it essential that formal in-service training on the practical aspects of environmental control be introduced into the curriculum of all relevant faculties. As examples: Economics courses might include consideration of the environmental and social hazards of unbridled economic growth; courses in Geology and Engineering might include instruction in the principles of conservation and the need for a proper balance between conservation and development; A Law Faculty might introduce a course on anti-pollution legislation.

   There was some discussion on the best way to influence in-service training of this type. The consensus of opinion was in favour of the establishment of suitable courses in all tertiary institutions. To this end, the working party recommended that the heads of tertiary institutions be asked to press for sufficient funds in the 1973-75 triennium to establish courses designed to give a comprehensive understanding of the human situation, particularly as it relates to the environmental crisis.

   The group also discussed the proposal made in Dr Stephen Boyden's paper for the establishment of full degree courses related to "The Science of Man" in all its aspects and including, suitably linked together, the following subjects: Human Biology (Evolution, Ecology, Genetics, Epidemiology, etc.), Psychology (including Social Psychology), Pre-history, Anthropology,

Demography, Social History, Sociology and Economics. The aim of these courses should be to produce graduates who have a comprehensive grasp of the knowledge which has been acquired in their various disciplines as it contributes to the understanding of the contemporary human situation in scientific terms.

Doubt was expressed by several members of the group as to whether graduates from such a generalised course would be able to find suitable future employment opportunities. Despite the doubts regarding future employment, there was substantial agreement amongst the working party that a holistic rather than a fragmented approach to the problems of modern man was necessary to deal with the environmental crisis. An analogy might be drawn with the general practitioner of medicine, whose responsibilities lie with the whole person in relation to his family and social environment.

The establishment of a Department for the Science of Man in one or more Australian universities would provide additional opportunities for research and for post-graduate study by those involved in education on the environmental crisis at secondary and tertiary levels.

Where Does the Responsibility Lie?

In a democratic society, it is the responsibility of educated citizens to promote awareness of environmental quality for the benefit of present and future generations. Such awareness is of vital concern for the creation of a favourable climate of opinion for legislative measures against pollution and the uncontrolled exploitation of mineral and fossil fuels.

Popular awareness of the physico-chemical and social problems posed by urban overcrowding and suburban sprawl will be a necessary prerequisite for effective democratic participation in such vital questions as the planning of new cities and of national policies regarding rates of population growth and eventual population stability.

The working group considered that tertiary institutions were in an unusually favourable position to promote education on environmental issues. Potentially, the most influential agencies were seen as being the teacher training colleges from which environmental sensitivity could be transmitted to all school children.

Recommendations for Action

The working party believed that a unique opportunity existed in Australia to reconsider the whole question of the relationships between man and his environment before activities harmful to the quality of human life and to the biosphere produce irreversible damage.

The following resolutions were formulated and adopted by the plenary session of the Conference:

1. That a copy of the report of this working group be sent to the heads of all tertiary institutions, and that they be urged to make provision in their 1973-75 triennial estimates for at least one post in their institution to be occupied by a senior academic who would concern himself with the provision of courses on the quality of the environment. Representations should also be made to the Australian Vice-Chancellors Committee.
   Although this recommendation seeks long term, lasting effects, action on implementing it should be immediate and urgent.
2. That encouragement and support be given by universities and colleges for on-campus seminars relating to the environmental crisis, including financial provisions for visiting lecturers.
3. That universities and colleges co-operate with outside bodies in the establishment of Field Studies Centres for educational and research purposes relating to the environmental crisis.
4. That consideration might be given for a review of entrance requirements to the tertiary level with regard to previous instruction in environmental science.
5. That, in consideration of the national importance of environmental education at the tertiary level, the Academy of Science be asked to approach a national body which would co-ordinate activities in education, research and publication on environmental issues. The working party considered that ANZAAS, which already enjoys the necessary prestige and administrative machinery at both the federal and state levels, would be well equipped to shoulder this burden.

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REPORT OF THE WORKING GROUP ON "THE EDUCATION OF ENVIRONMENTAL SCIENTISTS". By Ray Perry, Chairman*

Definition, Aims, Role and Function of Environmental Scientists

As far as the aims and function of environmental scientists are concerned, there was general agreement that environmental scientists are a family rather than a species – a family concerned with the integration in greater or lesser degree of disciplines concerning organisms and their environment, the maintenance and improvement of natural resources, and the conservation and improvement of the physical, cultural and psychological well-being of humans.

Stress was laid on training scientists within specific disciplines in the integration of their disciplines over the whole field of man and his environment, i.e. in ensuring that specialists get a holistic appreciation of the environment.

Mention was made that there are, and will be, few job opportunities for general practitioners in environmental science.

On the other hand there is a role for specialists in *systems in general* (systems analysts) – people who can plug into any part of the broad field of environmental science.

Present Situation and its Deficiencies

It was agreed that present arrangements for education are inadequate.

We are not training people with an integrated view of their discipline, as that discipline is related to other environmental disciplines.

The situation stems from:

1. Our adherence to an analytical approach to education and the pursuit of specialist research at the expense of applied research.
2. The present organisation of research and resource administration agencies. It was suggested that these might be better organised on a regional basis.
3. Lack of appreciation by present managers and administrators of the problems in conservation and management of the environment. The need for informing and enlightening such people was expressed.
4. The existing ethical and economic standards by which our society is governed.

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Methods of Achieving the Aims

1. Training at existing centres should produce graduates who are specialists in their own fields but knowledgeable in the integrated sense already described.
2. This would require changes in institutes of higher learning to a more synthetic system, i.e. a move towards the American "unit" course structure as opposed to the European system.
3. There was some discussion of the possibility of establishing "centres of excellence" within universities and colleges, mainly aimed at providing post-graduate courses for specialists, but also acting as centres of information.
4. It was recognised that training in environmental science was needed at several levels:
   a. Present students in Science, Engineering, Economics and the Humanities – in fact in all faculties – should receive extra training at undergraduate or postgraduate level.
   b. Refresher courses for existing scientists.
   c. Remedial training for present administrators and managers of resources and education.

There was a recognition of a need for courses of varying duration and power, (e.g. busy administrators might be able to attend only short intensive workshops).

There were some suggestions that people from research and management agencies should be involved in seminar courses.

Where Does the Responsibility Lie?

There was unanimous agreement that the responsibility for training environmental scientists lies with the places of tertiary education.

However, in addition, the research and management agencies, and individual members of their staffs, carry the additional responsibility for ensuring that the present ethical, economic and political climate be changed to one under which more funds and people are allocated to the training of environmental scientists.

The staff of universities and agencies must be involved in getting the message to all levels of the community. Organisations such as the Academy of Science, Australian Conservation Foundation, Clean Air Societies, etc. have an obvious role to play in this regard.

Apart from the actions implied above, there was a specific recommendation that the Conference set up a committee to ensure that the tenor of the discussion be transmitted to the Academy of Science for action.

Recommendations for Action

The following resolution was formulated and adopted, together with the rest of this report, by the plenary session of the Conference:

EDUCATION OF ENVIRONMENTAL SCIENTISTS

This Conference recognises that man has now reached the stage where the perturbation of the physical, aesthetic, social and economic environment is contributing a real threat to the continued existence of the world as a viable life system.

After examination of the problems posed by this realisation, it is evident that the adjustments necessary to achieve a return to a viable world require a re-examination of the fundamental moral and economic premises on which the dominant societies and economies of the world are based.

Recognising that as fundamental an overturning of contemporary values as this requires a great deal of public debate, the Conference states that it should be the role of all concerned people in the community, especially those at this Conference, by all means at their disposal, to create sufficient public awareness in Australia and the world to bring about the changes in moral and economic premises which will avert the crisis which confronts us.

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